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Operating Instuctions and Validation of Marine Fish Division, Scotia-Fundy Region's Survey Data Management System (SMS) and Delta Distribution Analysis Package (DAP)

by

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ABSTRACT

Marine Fish Division (MFD) of Scotia-Fundy Region has been collecting standardized groundfish survey data since 1970. Current versions of existing software systems such as STRAT and STRAP only allow limited access to the accumulated data set. A set of software was written and installed on the BIO Cyber 824 to allow easy access to the set by set survey information as well as to generate stratum by stratum and cruise by cruise mean and variance estimates based on the normal and delta distribution. A description and operating instructions of each system are provided in this document. As well, the output of SMS and DAP is validated against comparable output from STRAP and APL software available at BIO. The validation exercise uncovered no significant differences between SMS/DAP and STRAP/APL (BIO) output and this was taken as validation of the results of SMS/DAP.

RESUME

La Division des pêches marines (MFD) de la Région Scotia-Fundy collecte des données normalisées sur les poissons de fond depuis 1970. Les versions actuelles de systèmes de logiciels comme le STRAT et le STRAP ne permettent qu'un accès limité aux ensembles de données accumulées. Un ensemble de logiciel a été rédigé puis installé sur le Cyber 824 de l'Institut Océanographique de Bedford (IOB) afin de faciliter l'accès à l'ensemble par des informations de relevé d'ensemble et de manière à produire des estimations de moyenne et de variance strate par strate et croisière par croisière en s'appuyant sur la distribution normale et sur la distribution delta. Le présent document contient une description et un mode d'emploi de chaque système. Dans un même temps, la sortie de SMS et de DAP est validée en fonction de sorties comparables provenant de STRAP et du logiciel d'APL disponible à IOB. L'exercise de validation n'a révélé aucune différence significative entre l'extrant de SMS/DAP et l'extrant de STRAP/APL (IOB), c'est pourquoi ceci a été pris comme une validation des résultats de SMS/DAP.

INTRODUCTION

Marine Fish Division (MFD) of the Scotia-Fundy Region has been conducting stratified random groundfish surveys on the Scotian Shelf since 1970 (Doubleday, 1981). These surveys are used to provide annual estimates of abundance, along with the associated variance, which are used in the development of harvest advice for the fishing industry.

Halliday and Kohler (1971) discuss both the on-board data logging procedures and the subsequent coding of this information on a set of four 80 column records. Little modification to this data collection phase has occurred since then. On the other hand there have been significant improvements to the data editing/auditing (Anon. 1982), data storage and data analysis of this information. Since 1976, MFD has been active in cataloging all Divisional data sets in a library system which can be easily accessed through a facility called GETDATA. This process is now complete. Development of analysis software commenced with the STRAT system which was resident on the St. Andrews Biological Station's HP3000 computer during 1971-85. This system provided estimates of arithmetic mean number and weight per tow, along with the associated variance, using algorithms appropriate for this survey design (Cochran, 1977). The software is written in FORTRAN 66, is undocumented, limited in its analysis capabilities, and can only generate hardcopy output. The latter consisted of set by set, stratum by stratum, and cruise by cruise estimates of age and length specific survey abundance and biomass, both on a per tow and total area basis. Variance estimates were also provided but were incorrect when there was only one set conducted in a stratum. In this case, STRAT would assign a variance of zero when it should have been undefined. In addition, STRAT did not allow for user specified data transformations which severely limited its usefulness.

Due to the deficiencies of STRAT, MFD decided to install the Newfoundland-developed STRAP system (Smith and Somerton, 1981) on the HP3000 computer in 1985. STRAP allows for simple user-directed transformation options, handles the variance calculations appropriately, and is well documented. It either removes strata with one set or allows the user to combine these strata with others. However, it does not include estimators for the delta distribution (Pennington, 1983) and like STRAT generates only hard copy output.

For the assessment of the NAFO Division 4X haddock resource (O'Boyle and Gregory, 1985), it was decided to develop a set of software that would A) allow computer access to the set by set information and B) correctly calculate the arithmetic variance plus allow use of the delta transformation. Two separate systems were developed. The first, called the Survey Data Management System (SMS) combines the set of four 80 column records into a mini-data base which can be accessed either through commercially available packages

such as SPSS or through custom software. The second, called the Delta distribution Analysis Package (DAP), consists of a program that generates the appropriate mean and variance estimators of the normal and delta distribution. Both SMS and DAP are written in ANSII standard FORTRAN 77.

The present document provides a description of and operating instructions for both SMS and DAP along with a preliminary validation of the output. Validation of SMS was conducted through comparison of its results with those of STRAP for two cruises of NAFO Division 4X haddock data. Validation of the arithmetic estimators of DAP was done in a similar manner. Validation of the delta distribution estimators was conducted through comparisons with the results of a set of APL programs written by S.J. Smith (MFD, BIO).

DESCRIPTION AND OPERATING INSTRUCTIONS

SMS

Overview:

SMS processes survey information on a tow by tow basis. Essentially, the set of four 80 column records including station and set card, catch cards, length frequency cards and fish cards are combined into one long record which includes not only fish catch data but also information on tow characteristics such as position, duration, speed, etc., and environmental conditions such as temperature and salinity. Three steps are involved:

1. Selection of groundfish data from MFD tape library using GETDATA, and program SELECT, followed by a sort using the facility CALLSMG.

2. Reformating of the sorted data using SRPREP.

3. Processing of the SRPREP-generated data on a tow by tow basis using SRSET.

The file generated by SRSET consists of 1100 column long records, one per tow, which can be accessed using packages such as SAS, SPSS, MFDPLOT, etc. The control card deck for establishment of a SPSS file that was used in the 4X haddock assessment is included here for illustration.

Selection of Groundfish Data:

The groundfish survey data resides in a tape library which can be accessed through the MFD facility called GETDATA. Complete documentation on this software can be obtained directly from MFD, BIO. An example run is given below for illustrative purposes.

The extraction of the data from the library should be done in BATCH mode. However, it is advisable to see what is in the library

before attempting an extraction. This can be done using the LIST (L) command of GETDATA. Appendix Ia shows such a library access for data of cruises N031 and N032. Note that the library stores the information for each card type on each cruise separately. Thus, retrieval of card types 5, 6, 7, and 8 for cruise N031 and N032 requires use of the range option of GETDATA i.e. N03105-N03108. Once it is verified that the data desired resides in the library, a batch job can be submitted using the EXTRACT (E) option (Appendix Ib). Before doing an extraction it is worthwhile seeing whether or not the account file limits will allow storage of a file of the size indicated by the LIST run. If not, one can execute the next step of the selection process, the program SELECT, in batch mode as well. This program (Appendix IIa) selects from the input (TAPE 1) all card type 5 records (station and set cards), and those card type 6 (catch), 7 (length-frequency), and 8 (fish) records having species code 0011 (haddock) in strata 70 to 95.

The output of SELECT (TAPE 2) is then sorted using the MFD utility CALLSMG, by cruise (key field 2), set (key field 3), and card type (key field 1) in that order. The key fields are defined by the file given in Appendix IIb, labelled KEYS in the following CALLSMG command:

```
CALLSMG, in = TAPE 2, Out = TAPE 1, Keyfile = KEYS, Keyseq = 231
```

Once sorted by this command, the file, TAPE 1, is ready for reformating by the program SRPREP.

Reformating by SRPREP:

The program, SRPREP, is shown in Appendix III. It converts the sorted card type 5, 6, 7, and 8 records output from utility CALLSMG into a long record of 4000 characters on a tow by tow basis. The details of what fields are selected and how they are arranged on the output of SRPREP can be determined from Table 1. SRPREP also does a number of modifications to the selected data. First, all card type 5 records are selected. Thus, if no haddock was caught on a set, the record is zero filled. Second, only 56 two centimeter length groupings are handled by the software. This is more than enough for haddock. Any length data longer than the 56th length grouping (110.5 cm) will automatically be deleted. Finally, a code "99" is placed in the age field in the following situations:

1. Age Material (col. 64) = 9 (None)
2. Edge Type (col. 67) = 5 (crystallized)
3. Age (cols. 71-72) = Blank

SRPREP generates a record that will accept up to 300 card type 8 (fish) records, which is more than enough for most survey situations.

Processing by SRSET:

Program SRSET (Appendix IV) converts the raw data generated by SRPREP into a file containing numbers at age, weight at age, and numbers at length per standard tow. The file of 4000 column length records (TAPE 2) produced by SRPREP is thus reduced to one with 1100 column length records (TAPE 4). Each cruise of data is processed separately in the following sequential manner:

1. A length vector is converted to a weight vector using a user defined length-weight relationship. In this software, the inshore strata (90-95) are handled differently from the offshore strata (70-85) based on previous analysis (O'Boyle et al., 1983).

2. Each cruise of data is extracted and temporarily stored on a scratch file (TAPE 3).

3. The program reads through the scratch file twice. The first time through, it creates the age-length keys, one for the inshore and another for the offshore strata.

4. In the second pass through the scratch file, the length-frequency and weight-frequency information are converted to numbers and weight at age respectively using the inshore and offshore age-length keys. During this process, the tow catch numbers and weight are standardized to a tow distance of 1.75 nautical miles.

In addition, in cases where no age material is available for the first 6 length groupings, the age is assumed to be zero (i.e. young of the year). All other unaged length groupings are assigned to the unknown age grouping.

The final output format (TAPE 4) can be obtained from Table 1.

Further Processing:

The output of SRSET (TAPE 4) readily avails itself to further processing in that it is a sequential record file, each record contains information on each tow of the survey. A number of options are possible. The one presented here (Appendix V) uses SPSS to generate a mini-data base along with variable labels. The variable modification features of SPSS also allow the creation of new variables (i.e. 5+ numbers per tow) as well as correction for survey vessel differences (i.e. multiply A.T. Cameron data by 1.2).

DAP

Overview:

DAP uses as its input data a sequential file of set by set survey numbers at age per tow information generated by the SMS package. DAP consists of only one FORTRAN 77 program called DELTA which processes the survey data and provides a file of information which can be either routed to the line printer or accessed for further processing.

Program DELTA:

DELTA (Appendix VI) executes the following steps:

1. Sets up cruise ID and stratum weighting arrays. The latter currently are specific to NAFO Div. 4X. Up to 26 strata can be specified. In this step, all arrays are initialized.

2. Reads in the set by set cruise data from file INDATA in the following format:

Data Element	Format
Cruise ID	A4
Stratum	I2
Set No.	I2
Age by Age No. per tow	I6 (F9.3)

3. Calculates the stratum by stratum estimates of the mean and variance based on the Delta distribution. Subroutines DELEMA and BES are called to carry out the calculations. The stratum mean is calculated according to equation 1 of Apendix VII. The stratum variance is calculated as per equation 2 and the estimated variance of the stratum mean as per equation 4 of Appendix VII. The Bessel function (equation 3 of Appendix VII) used in all the equations converges to a constant value dependent on the size of the ADD part of the equation. When this part becomes less than 0.00001, convergence stops and value for the function is calculated. If the stop condition is not reached in 25 iterations, the error message "CONVERGENCE PROBLEMS IN SUBROUTINE BES" is printed.

4. Calculates stratified mean and variance estimates for the cruise. These are calculated as per Cochran (1977) or:

$$\bar{Y}_{st} = \sum_{h=1}^{L} W_h \bar{Y}_h$$

= stratified mean where $\bar{Y}_h$ is the arithmetic mean for the standard application and is the Delta mean (equation 1, Appendix VII) for the Stratified Delta estimator.

$$Var(\bar{Y}_{st}) = \frac{1}{N^2} \sum_{h=1}^{L} N_h (N_h - n_h) Var(\bar{Y}_h)$$ = estimated variance of the stratified mean.

where: N_h = maximum number of sampling units in stratum h.
$N = N_1 + N_2 + N_3 + \ldots N_L$
n_h = observed number of sampling units in stratum h.
$W_h = N_h/N$ or the stratum weighting

$Var(Y_h) = \frac{S_h^2}{n_h}$ for the arithmetic mean and equation 4 of Appendix VII for the Delta mean.

The stratified mean is calculated using the information for all strata. However, the variance is calculated differently depending on whether an arithmetic or delta estimator is desired. In the former case, the variance is calculated using only those strata with greater than one set. In the latter case, the variance is calculated using the information from all strata. In this case, if there is only one set, the variance will be calculated as either x^2 or 0 depending on whether or not x is a non-zero or zero value (equation 4, Appendix VII).

5. Outputs the various calculated parameters for each stratum of each cruise on a file called "TABLES".

6. Outputs the various calculated parameters for each cruise on separate files:

Parameter	File Name
Delta Mean	DELTMEN
Delta Variance	DELTVAR
Arithmetic Mean	ARMEAN
Arithmetic Variance	ARVAR

VALIDATION OF SMS AND DAP

SMS

The selection and reformating of the raw survey data (steps 1 and 2) are straight-forward and not considered here. The two components of the program SRSET - the creation of the age-length keys and the creation of the set by set numbers at age caught per tow will be examined in detail. The data used is that of 4X haddock caught in strata 70 to 95 on cruises N031/N032 (July, 1984) and N048/N049 (July, 1985). The comparisons were made with the results of STRAP, the latter considered as the standard for MFD.

Validation of the Generation of the Age-Length Keys:

The age-length keys for the STRAP runs and the equivalent keys generated by SMS are given in Tables 2 and 3. There was perfect agreement between the two systems in all cases for both the 1984 and 1985 results. This was taken as confirmation of the SMS results in relation to the production of age-length keys.

Validation of the Generation of Set by Set Numbers at Age Caught Per Tow:

The results of this comparison are shown in Tables 4 and 5. First, for both N031/32 and N048/49, the set selection criteria generated the same number of sets in each system. Second, in general the total numbers caught per tow was within 1% agreement. In most cases agreement was perfect. However in some cases, particularly for large catches, differences were observed in the second decimal place. The cause for this (S.J. Smith, pers. comm.) was determined to be the method of proration of the catch when subsampling had occurred. In SMS, the number caught per tow is that coded on the card type 6 (catch) record. Proration to adjust for subsampling has already been accounted for by staff in the data processing centre in St. Andrews. STRAP uses the ratio value coded on the catch card and the calculated number of fish sampled to determine the numbers caught. If the ratio is accurate, then STRAP and SMS should generate the same results. As they don't, it is evident that rounding errors, either by St. Andrews staff or in the ratio value are causing the difference. This problem is presently under investigation. Nevertheless, the differences between STRAP and SMS are not significant.

The above problem can account for differences between STRAP and SMS in the numbers caught at age for the subsampled sets. Differences in the remaining sets require further explanation. As these differences were slight, it was suspected that the FORTRAN compilers on the Cyber at BIO and the HP3000 in St. Andrews were rounding differently. The compiler on the HP3000 is that of FORTRAN 66. Consequently a small test program (Figure 1) was written and run on both machines. The Cyber rounds values 4 and below down and 5 and above up. The HP3000 on the other hand rounds 1-5 down and 6-9 up. Consequently, on average the Cyber results will be slightly larger, in the second decimal place, than the HP3000 results. This was indeed the case. Given the small differences and their direction, this explanation is considered the likely cause for discrepancies in the non-subsamped sets.

DAP

Validation of the arithmetic results of the DAP software involved the extraction of the 4X haddock data for cruise N031/N032 (summer, 1984) and cruise N048/N049 (summer, 1985) from the survey tape library using the SMS system, and, upon execution of DAP, comparison of stratum by stratum results from DAP with those from STRAP.

Validation of DAP with STRAP could only be done to the stratum level. DAP generates cruise by cruise estimates whereas STRAP does so under certain restrictions. In DAP, strata 92 to 94 are excluded (not considered part of the 4X haddock resource), and age-length keys constructed separately for strata 70-85 and 90-95. These are applied to the set by set length frequencies to generate set by set age data. The latter is then weighted together for the cruise using the stratum areas. The current version of STRAP only allows the generation of stratum by stratum mean and variance estimates and cruise mean estimates based on only one age-length key.

Validation of the delta estimators from DAP was conducted in a similar fashion. However only the N048/N049 survey data were used. In addition, as STRAP does not generate delta estimators, DAP results were compared to those of APL software written by S. Smith (MFD-BIO).

VALIDATION OF THE GENERATION OF ARITHMETIC ESTIMATORS

Comparison of the stratum by stratum arithmetic estimators (mean and variance) for cruises N031/N032 (Tables 6 and 7) and N048/N049 (Tables 8 and 9) showed excellent agreement between STRAP and DAP. As with SMS-STRAP comparisons, differences were in the second decimal place. These differences can be explained by the subsampling and ratio calculation problem noted earlier.

VALIDATION OF THE GENERATION OF DELTA ESTIMATORS

S.J. Smith (pers. comm.) has written for the IBM PC an APL program to generate delta estimators given a set of cruise data. This program was run on the N048/N049 data and compared to the DAP output on a stratum by stratum (Tables 10 and 11) basis. There was virtually perfect agreement between the two sets of software.

CONCLUSIONS

The SMS/DAP system was written to allow easy access to the 4X haddock survey data. This system not only allows access to the raw, set by set biological and environmental information but generates stratum by stratum and cruise by cruise mean and variance estimators based on the normal and delta distribution. The software has been validated, to the set and stratum level, with the STRAP system installed on the HP3000 computer at the St. Andrews Biological Station. Agreement of the output of both systems was always better than five percent and most frequently better than one percent. Sources of disagreement have been found to be 1) handling by STRAP and DAP of subsampled catches and 2) differences in rounding by the HP3000 and the Cyber 824. These differences are not considered significant and SMS/DAP is determined to be validated correctly in relation to STRAP.

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Table 1. Files used and generated by SMS.

Date Element	Tape 1 of SRPREP Column	Tape 1 of SRPREP Format	Tape 2 of SRSET Column	Tape 2 of SRSET Format	Tape 4 of SRSET Column	Tape 4 of SRSET Format
	Card Type 5					
Cruise ID	2-5	A4	1-4	A4	1-4	A4
Stratum	7-8	A2	5-6	A2	5-6	A2
Set	9-10	A2	7-8	A2	7-8	A2
Day	11-12	F2.0	9-10	F2.0	9-10	F2.0
Month	13-14	F2.0	11-12	F2.0	11-12	F2.0
Year	15-16	F2.0	13-14	F2.0	13-14	F2.0
Unit Area	17-19	A3	15-17	A3	15-17	A3
Expt.	20	A1	18	A1	18	A1
Time	21-23	F3.1	19-21	F3.1	19-21	F3.1
Set Duration	24-25	F2.0	22-23	F2.0	22-23	F2.0
Gear	26-27	A2	24-25	A2	24-25	A2
Speed	29-31	F3.1	26-28	F3.1	26-28	F3.1
Position	33-40	A8	29-36	A8	29-36	A8
Bottom Depth	41-43	F3.0	37-39	F3.0	37-39	F3.0
Tow Distance	46-47	F2.1	40-41	F2.1	40-41	F2.1
Surface Temp.	52-54	F3.1	42-44	F3.1	42-44	F3.1
Bottom Temp.	55-57	F3.1	45-47	F3.1	45-47	F3.1
	Card Type 6					
Species	39-42	A4	48-51	A4	48-51	A4
No. Caught	43-47	F5.0	52-56	F5.0	52-61	F10.3
Wt. Caught	48-51	F4.0	57-60	F4.0	62-71	F10.3
	Card Type 7					
Length-Freq.	39-80	14F3.0	61-228	56F3.0	72-631	56F10.3
	Card Type 8					
Length	40-42	F3.0	229-	F3.0		
Sex	43	F1.0		F1.0		
Maturity	44	F1.0	300 x	F1.0		
Weight	45-49	F5.3		F5.3		
Age	71-72	F2.0	3828	F2.0		
Number at Age					632-841	21F10.3
Kg. at Age					842-1051	21F10.3

Table 2a. Age-length keys of haddock caught in strata 70-88 on Cruise NO31/NO32, generated by STRAP (A) and SMS (B).

A.

LENGTH	AGE IN YEARS 0	1	2	3	4	5	6	7	8	9	10	11	12	13	SUM
8.5	1														1
9.5	2														2
10.5	1														1
12.5															0
14.5		5													5
16.5		14	2												16
18.5		9	5												14
20.5		1	10	1											12
22.5		1	16	1											18
24.5			12	1											13
26.5			16	2											18
28.5			10	10											20
30.5			12	14	6										32
32.5			4	22	5										31
34.5		3		11	12										30
36.5			13	13											31
38.5			1	4	25										29
40.5			1	23	23	2									49
42.5				23	28	4									55
44.5				2	13	9									24
46.5				2	11	11									24
48.5					3	19	2								24
50.5					1	14	9	1							25
52.5						11	11	3	1						26
54.5					1	5	22	9							37
56.5						5	20	6	2						33
58.5						8	11	8	2	1					30
60.5							4	8	2	2					16
62.5							7	6	1	1					14
64.5							1	3	1	2	1				8
66.5							2	3		2				1	8
68.5								1	1	2					4
70.5										1	1	1			3
72.5										2			1		3
	4	34	137	104	164	88	89	44	15	13	2	1	1	1	697

B.

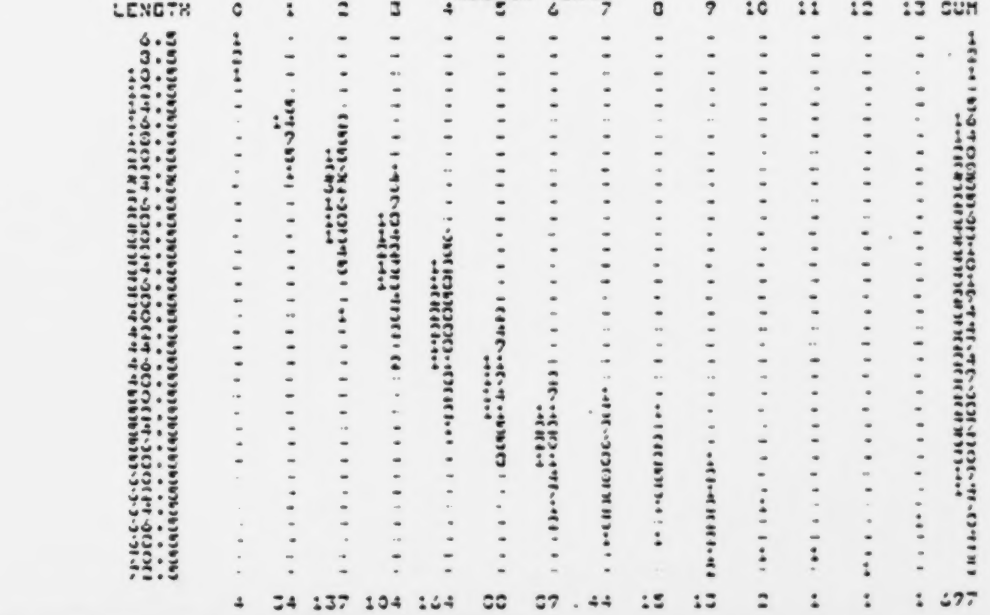


Table 2b. Age-length keys of haddock caught in strata 90-95 on Cruise N031/N032, generated by STRAP (A) and SMS (B).

A.

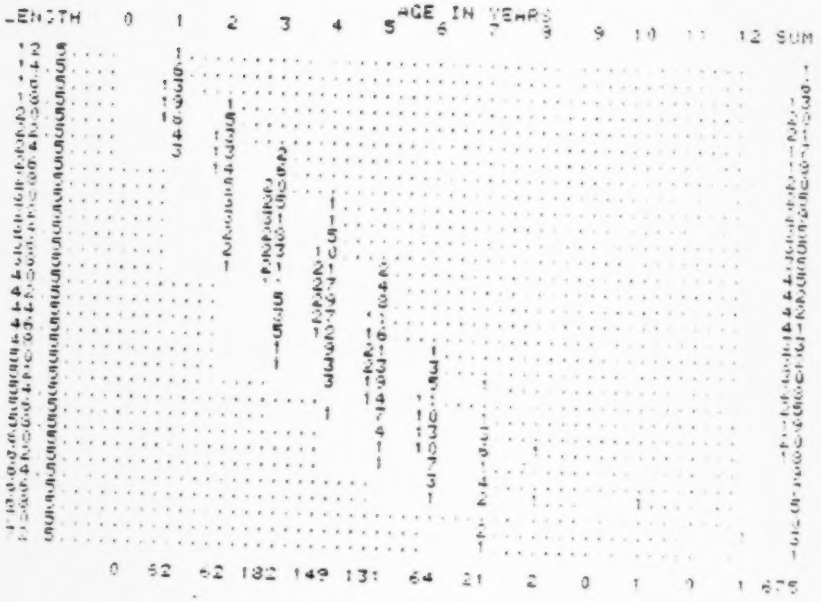
LENGTH	AGE IN YEARS 0	1	2	3	4	5	6	7	8	9	10	SUM
20.5		4										4
22.5		3	2									5
24.5		2	1									3
26.5		1	2									3
28.5			5									5
30.5			6	3								9
32.5			15	4								19
34.5			12	5								17
36.5			13	3	1							17
38.5			6	7	1							13
40.5				6	4							10
42.5				2	7							8
44.5			2	11	1							14
46.5			6	7	3							13
48.5			5	20	4							29
50.5				14	8	1						23
52.5				10	5	1						16
54.5				6	2	1						9
56.5				3	5	1						9
58.5				1	6	3	1					11
60.5				1			4	2				7
62.5							1					1
64.5						1	1	1				3
66.5								2				2
68.5												0
70.5												0
72.5											1	1
	0	10	61	43	88	34	8	7	5	0	1	257

B.

LENGTH	AGE IN YEARS 0	1	2	3	4	5	6	7	8	9	10	SUM
		4										
											1	1
	0	10	61	43	88	34	8	7	5	0	1	257

Table 3a. Age-length keys of haddock caught in strata 70-85 on Cruise N048/N049, generated by STRAP (A) and SMS (B).

A.



B.

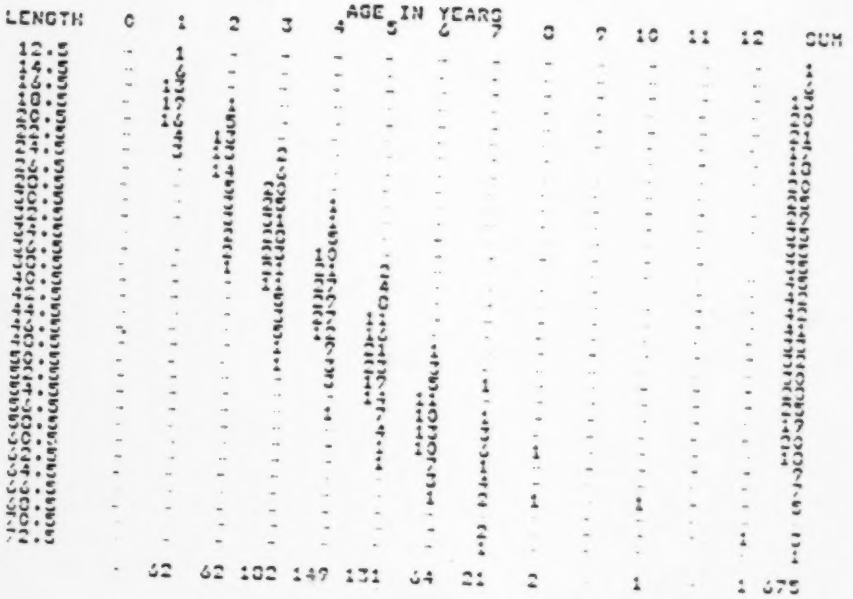
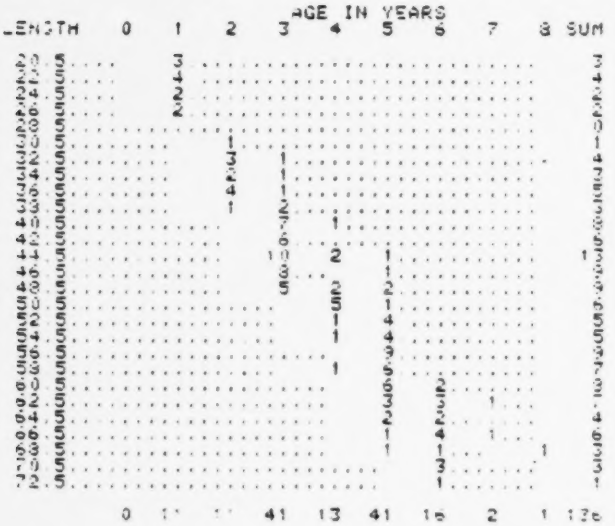


Table 3b. Age-length keys of haddock caught in strata 90-95 on Cruise N048/N049, generated by STRAP (A) and SMS (B).

A.



B.

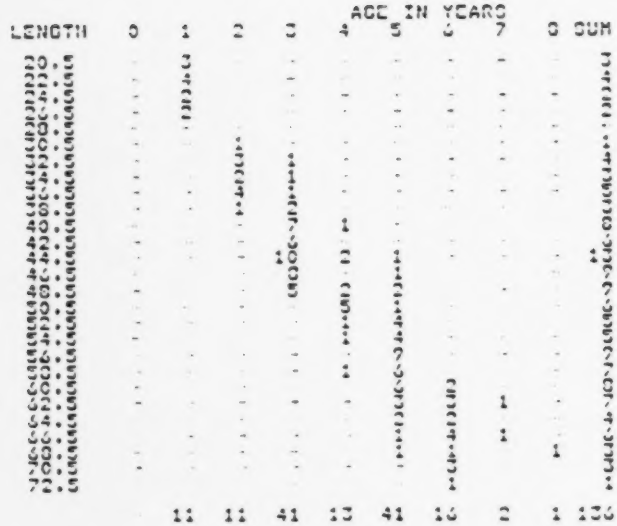


Table 4. Set by set numbers caught per standard tow generated by STRAP (A), SMS (B), and the difference (C) in these. Data is for 4X haddock from survey NO31/NO32 (summer, 1984).

A.

STRAP RESULTS
SURVEY NUMBERS AT AGE PER STANDARD TOW

STRATUM	SET	0	1	2	3	4	5	6	7	8	9	10	11	12	13	NK	TOTAL
1	1	.00	.00	.00	.00	.07	.36	.36	.10	.03	.00	.00	.00	.00	.00	.00	.92
2	2	.00	1.02	.15	.00	.08	.46	.46	.13	.04	.00	.00	.00	.00	.00	.00	2.33
3	3	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
4	4	2.06	16.07	31.80	9.81	17.04	7.32	6.84	3.43	1.19	.37	.00	.00	.00	.00	.00	95.74
5	5	.00	.00	.00	.09	3.97	4.14	2.34	.76	.04	.73	.00	.00	.37	.00	.00	14.13
6	6	.00	.00	.00	.28	2.46	.34	.00	.00	.00	.00	.00	.00	.00	.00	.00	3.09
7	7	.00	1.31	7.44	5.48	4.64	4.07	7.59	3.98	1.18	.41	.03	.00	.00	.00	.00	36.09
8	8	.00	7.99	35.65	20.31	10.35	3.64	4.46	2.20	.54	.19	.00	.00	.00	.00	.00	85.31
9	9	1.03	.29	11.77	36.47	151.51	36.75	8.17	2.16	.58	.18	.00	.00	.00	.00	.00	247.66
10	10	.00	.69	12.83	36.79	239.89	125.91	57.95	16.41	3.60	.51	.00	.00	.00	.00	.00	494.61
11	11	.00	1.04	11.82	1.95	3.65	1.56	1.06	1.34	.48	.43	.00	.00	.00	.00	.00	24.41
12	12	.00	1.13	15.02	7.43	18.09	7.46	3.42	1.11	.42	.07	.00	.00	.00	.00	.00	54.15
13	13	.00	.04	9.41	18.51	36.78	7.44	4.11	1.64	.24	.07	.00	.00	.00	.00	.00	78.24
14	14	.00	.00	24.04	7.62	20.30	4.86	5.39	3.27	1.72	.50	.00	.00	.00	.00	.00	67.79
15	15	10.29	12.54	45.41	11.57	12.51	7.36	2.49	1.16	.17	.33	.00	.00	.00	.00	.00	103.97
16	16	.00	.00	.00	.55	1.63	2.84	3.69	1.39	.85	.19	.00	.00	.00	.00	.00	10.94
17	17	.00	.00	.22	.78	3.47	1.85	3.71	2.07	1.30	.86	.00	.00	.00	.00	.00	14.46
18	18	.00	.04	.96	.44	4.13	1.15	.50	.04	.00	.00	.00	.00	.00	.00	.00	7.26
19	19	.00	.00	.51	2.33	8.67	.77	.00	.00	.00	.00	.00	.00	.00	.00	.00	12.28
20	20	.00	18.55	190.01	38.63	65.72	20.13	3.02	1.08	.55	.00	.00	.00	.00	.00	.00	339.61
21	21	.00	170.70	1004.02	394.43	279.18	44.76	4.24	.41	.00	.00	.00	.00	.00	.00	.00	1899.84
22	22	.00	.70	17.85	7.32	4.61	.83	.15	.00	.00	.00	.00	.00	.00	.00	.00	32.47
23	23	.00	.00	1.11	1.38	11.80	4.41	1.11	.14	.00	.00	.00	1.03	.00	.00	.00	19.78
24	24	.00	.00	1.72	2.02	24.46	10.57	2.45	1.12	.64	.00	.00	.00	.00	.00	.00	44.98
25	25	.00	.00	.73	.99	4.54	1.81	.37	.16	.03	.00	.00	.00	.00	.00	.00	8.64
26	26	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
27	27	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
28	28	.00	.00	.00	.70	3.74	2.83	.79	.19	.00	.00	.00	.00	.00	.00	1.93	9.77
29	29	.00	1.09	20.35	12.85	14.87	4.79	.70	.31	.00	.00	.00	.00	.00	.00	.00	55.67
30	30	.00	.00	5.45	4.13	11.20	4.09	1.25	.00	.00	.00	.00	.00	.00	.00	.00	26.19
31	31	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
32	32	.00	.00	5.87	1.34	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	7.21
33	33	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
34	34	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
35	35	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
36	36	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
37	37	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
38	38	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
39	39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	48	.97	.66	41.25	11.13	64.07	11.36	2.15	.85	.00	.00	.00	.00	.00	.00	.00	131.44
49	49	1.74	49.31	146.67	27.06	13.04	4.44	.72	.14	.03	.00	.00	.00	.00	.00	.00	243.66
50	50	.00	.00	3.04	4.28	7.45	6.67	11.15	5.47	1.66	1.48	.00	.00	.00	.00	.00	41.81
51	51	.00	.00	1.09	1.46	1.57	.34	.00	.00	.00	.00	.00	.00	.00	.00	.00	4.46
52	52	3.09	51.62	54.78	16.85	20.36	5.54	3.11	.86	.10	.00	.00	.00	.00	.00	.00	156.41
53	53	1.33	15.12	49.36	14.84	9.93	.89	.45	.11	.04	.00	.00	.00	.00	.00	.00	92.14
54	54	.00	.00	2.88	1.12	10.70	1.58	.00	.00	.00	.00	.00	.00	.00	.00	.00	16.28

B.

SMS RESULTS
SURVEY NUMBERS AT AGE PER STANDARD TOW

STRATUM	SET	0	1	2	3	4	5	6	7	8	9	10	11	12	13	NK	TOTAL
1	1	.00	.00	.00	.00	.07	.36	.36	.10	.03	.00	.00	.00	.00	.00	.00	.92
2	2	.00	1.02	.15	.00	.08	.46	.46	.13	.04	.00	.00	.00	.00	.00	.00	2.33
3	3	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
4	4	2.06	16.07	31.80	9.81	17.04	7.32	6.84	3.43	1.19	.37	.00	.00	.00	.00	.00	95.74
5	5	.00	.00	.00	.09	3.97	4.14	2.34	.76	.04	.73	.00	.00	.37	.00	.00	14.13
6	6	.00	.00	.00	.28	2.46	.34	.00	.00	.00	.00	.00	.00	.00	.00	.00	3.09
7	7	.00	1.31	7.44	5.48	4.64	4.07	7.59	3.98	1.18	.41	.03	.00	.00	.00	.00	36.09
8	8	.00	7.99	35.65	20.31	10.35	3.64	4.46	2.20	.54	.19	.00	.00	.00	.00	.00	85.31
9	9	1.03	.29	11.77	36.47	151.51	36.75	8.17	2.16	.58	.18	.00	.00	.00	.00	.00	247.66
10	10	.00	.69	12.83	36.79	239.89	125.91	57.95	16.41	3.60	.51	.00	.00	.00	.00	.00	494.61
11	11	.00	1.04	11.82	1.95	3.65	1.56	1.06	1.34	.48	.43	.00	.00	.00	.00	.00	24.41
12	12	.00	1.13	15.02	7.43	18.09	7.46	3.42	1.11	.42	.07	.00	.00	.00	.00	.00	54.15
13	13	.00	.04	9.41	18.51	36.78	7.44	4.11	1.64	.24	.07	.00	.00	.00	.00	.00	78.24
14	14	.00	.00	24.04	7.62	20.30	4.86	5.39	3.27	1.72	.50	.00	.00	.00	.00	.00	67.79
15	15	10.29	12.54	45.41	11.57	12.51	7.36	2.49	1.16	.17	.33	.00	.00	.00	.00	.00	103.97
16	16	.00	.00	.00	.55	1.63	2.84	3.69	1.39	.85	.19	.00	.00	.00	.00	.00	10.94
17	17	.00	.00	.22	.78	3.47	1.85	3.71	2.07	1.30	.86	.00	.00	.00	.00	.00	14.46
18	18	.00	.04	.96	.44	4.13	1.15	.50	.04	.00	.00	.00	.00	.00	.00	.00	7.26
19	19	.00	.00	.51	2.33	8.67	.77	.00	.00	.00	.00	.00	.00	.00	.00	.00	12.28
20	20	.00	18.55	190.01	38.63	65.72	20.13	3.02	1.08	.55	.00	.00	.00	.00	.00	.00	339.61
21	21	.00	170.70	1004.02	394.43	279.18	44.76	4.24	.41	.00	.00	.00	.00	.00	.00	.00	1899.84
22	22	.00	.70	17.85	7.32	4.61	.83	.15	.00	.00	.00	.00	.00	.00	.00	.00	32.47
23	23	.00	.00	1.11	1.38	11.80	4.41	1.11	.14	.00	.00	.00	1.03	.00	.00	.00	19.78
24	24	.00	.00	1.72	2.02	24.46	10.57	2.45	1.12	.64	.00	.00	.00	.00	.00	.00	44.98
25	25	.00	.00	.73	.99	4.54	1.81	.37	.16	.03	.00	.00	.00	.00	.00	.00	8.64
26	26	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
27	27	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
28	28	.00	.00	.00	.70	3.74	2.83	.79	.19	.00	.00	.00	.00	.00	.00	1.93	9.77
29	29	.00	1.09	20.35	12.85	14.87	4.79	.70	.31	.00	.00	.00	.00	.00	.00	.00	55.67
30	30	.00	.00	5.45	4.13	11.20	4.09	1.25	.00	.00	.00	.00	.00	.00	.00	.00	26.19
31	31	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
32	32	.00	.00	5.87	1.34	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	7.21
33	33	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
34	34	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
35	35	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
36	36	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
37	37	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
38	38	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
39	39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	48	.97	.66	41.25	11.13	64.07	11.36	2.15	.85	.00	.00	.00	.00	.00	.00	.00	131.44
49	49	1.74	49.31	146.67	27.06	13.04	4.44	.72	.14	.03	.00	.00	.00	.00	.00	.00	243.66
50	50	.00	.00	3.04	4.28	7.45	6.67	11.15	5.47	1.66	1.48	.00	.00	.00	.00	.00	41.81
51	51	.00	.00	1.09	1.46	1.57	.34	.00	.00	.00	.00	.00	.00	.00	.00	.00	4.46
52	52	3.09	51.62	54.78	16.85	20.36	5.54	3.11	.86	.10	.00	.00	.00	.00	.00	.00	156.41
53	53	1.33	15.12	49.36	14.84	9.93	.89	.45	.11	.04	.00	.00	.00	.00	.00	.00	92.14
54	54	.00	.00	2.88	1.12	10.70	1.58	.00	.00	.00	.00	.00	.00	.00	.00	.00	16.28

Table 4. (Continued)

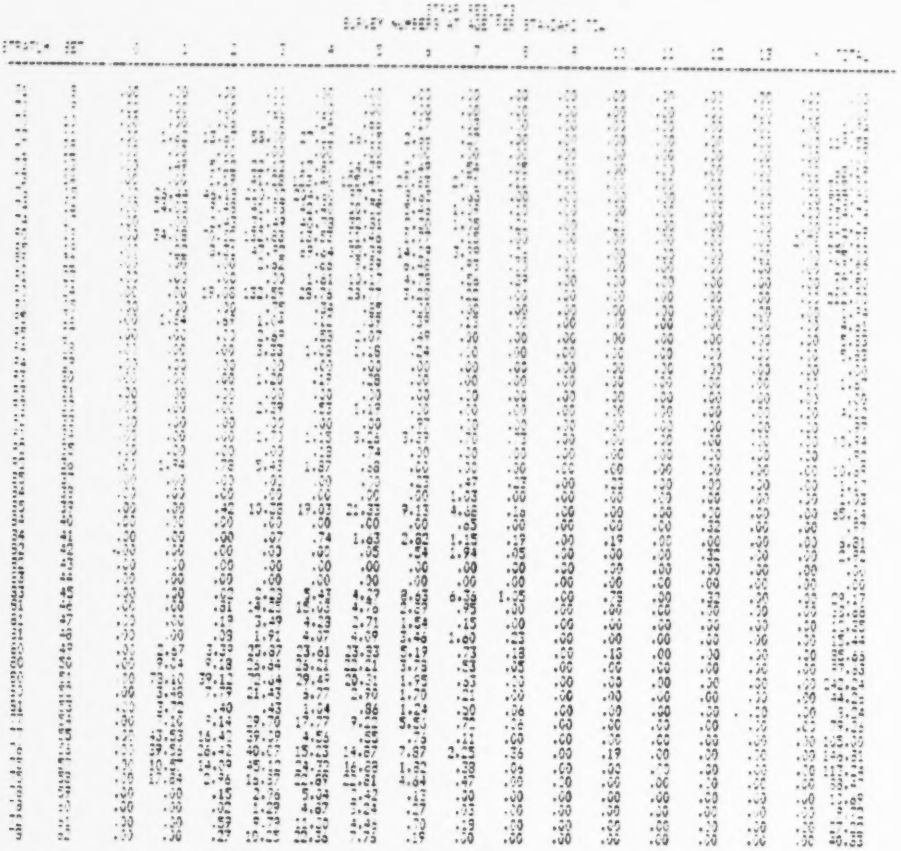
C.

(BMS RESULTS - STRAP RESULTS) / STRAP RESULTS

STRATUM	SET	0	1	2	3	4	5	6	7	8	9	10	11	12	13	NK	TOTAL
	1	-	-	-	-	.00	.00	.00	.00	.00	-	-	-	-	-	-	.00
		-	.00	.00	-	.00	.00	.00	.00	.00	-	-	-	-	-	-	.00
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	.00
		-	-	-	.00	.00	.00	.00	.00	.00	.00	-	-	.03	-	-	.00
		-	-	-	.00	.00	.00	-	-	-	-	-	-	-	-	-	.00
		-	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	.00
		-	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	.00
		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	.00
		-	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	.00
		-	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	.00	-	.00
		-	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	.00
		-	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	.00
		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	.00	-	.00
		-	-	-	.00	.00	.00	.00	.01	.00	.00	-	-	-	-	-	.00
		-	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	-	.00
		-	-	.00	.00	.00	.00	-	-	-	-	-	-	-	-	-	.00
		-	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	.00
		-	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	-	.00
		-	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	-	-	.00
		-	-	.00	.00	.00	.00	.00	.00	.00	-	.00	-	-	-	-	.00
		-	-	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	.00
		-	-	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	.00
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		-	-	-	.00	.00	.00	.01	.00	-	-	-	-	-	-	.00	.00
		-	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	.00
		-	-	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	-	.00
		-	-	-	-	.00	-	-	.00	.00	-	-	-	-	-	-	.00
		-	-	.00	.00	-	-	-	-	-	-	-	-	-	-	-	.00
		-	-	-	-	-	-	.00	.00	.00	-	-	-	-	-	-	.00
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		-	-	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	.03	-	-	.00
		-	-	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	.00
		-	-	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	.00	-	.00
		-	-	-	-	-	.04	.00	.04	.00	.00	-	-	-	-	-	.00
		-	-	-	-	-	.04	.00	.04	.00	.00	-	-	-	-	-	.00
		-	-	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	.00	-	.00
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	.00
		-	-	-	-	-	.00	.00	.00	.00	.00	.00	.00	.03	.00	-	.00
		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	.00
		.00	.00	.00	.00	.00	.00	.00	.00	.33	-	-	-	-	-	-	.00
		-	.33	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	-	.03	-	.00
		-	-	.00	.00	.00	.00	-	-	-	-	-	-	-	-	-	.00
		.00	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	.00
		.00	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	.00
		-	-	.00	.00	.00	.00	-	-	-	-	-	-	-	-	-	.00

Table 5. Set by set numbers caught per standard tow generated by STRAP (A), SMS (B), and the difference in these (C). Data is for 4X haddock from surveys N048/N049 (summer, 1985).

A.



B.

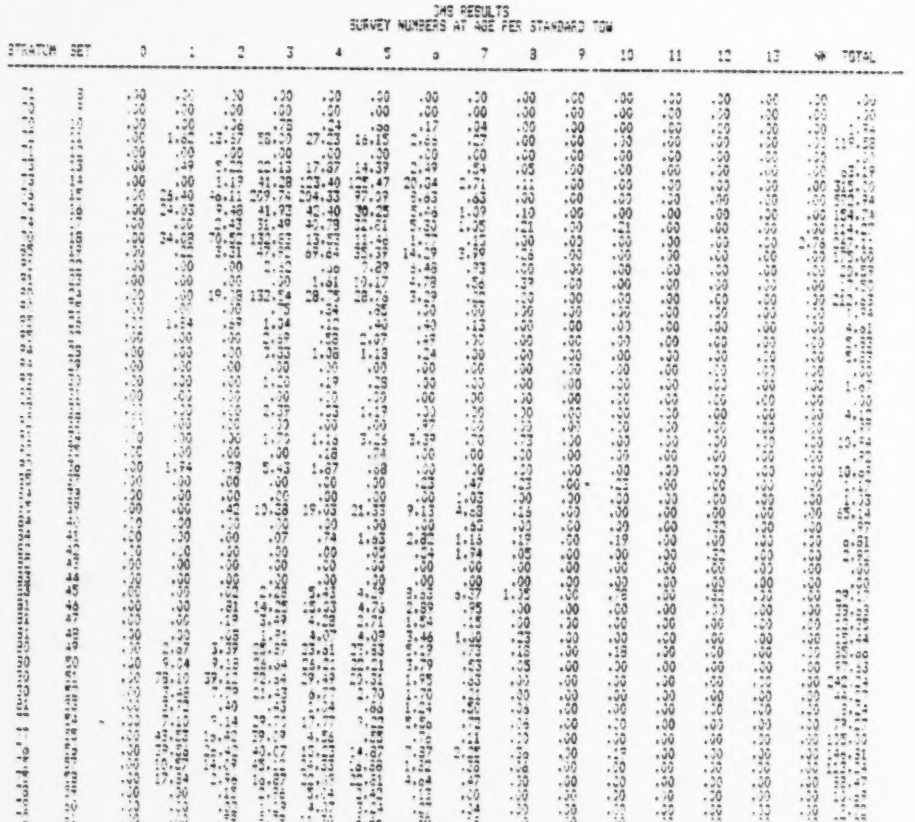


Table 5. (Continued)

C.

(BMS RESULTS - STRAP RESULTS) / STRAP RESULTS

STRATUM	SET	0	1	2	3	4	5	6	7	8	9	10	11	12	13	NK	TOTAL
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		-	-	.00	.00	.00	.00	.00	.33	-	-	-	-	-	-	-	.00
		-	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	-	.00
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		-	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	.00
		-	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	.00
		-	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	.00
		-	.00	.00	.00	.00	.00	.00	.00	.00	-	.00	-	-	-	-	.00
		-	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	.00	.00
		-	-	-	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	.00
		-	-	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	.00
		-	.00	.00	.00	.00	.03	.03	.00	-	-	-	-	-	-	-	.00
		-	-	-	.00	.00	.00	.00	-	-	-	-	-	-	-	-	.00
		-	-	-	.00	.00	.00	.00	-	-	-	-	-	-	-	-	.00
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		-	-	-	.00	.00	.00	-	-	-	-	-	-	-	-	-	.00
		-	-	-	-	-	-	.00	-	-	-	-	-	-	-	-	.00
		-	-	-	.00	.01	.00	.00	.00	.00	-	.00	-	-	-	-	.00
		-	.00	.00	.00	.00	.00	-	-	-	-	-	-	-	-	-	.00
		-	-	-	-	-	-	.00	.00	.00	-	.00	-	-	-	-	.00
		-	-	-	-	-	-	-	.00	-	-	-	-	-	-	-	-
		-	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	.00
		-	-	-	-	-	-	-	.00	-	-	-	-	-	-	-	-
		-	-	-	.00	.00	.00	.00	.01	.00	-	.00	-	-	-	-	.00
		-	-	-	-	-	.00	.00	.00	.00	-	-	-	.00	-	-	.00
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		-	-	.00	.00	.00	.00	.00	.00	.00	-	.00	-	.00	-	-	.00
		-	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	.00
		-	.00	.00	.00	.00	.00	.00	.00	.00	-	.00	-	-	-	-	.00
		-	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	-	.00
		-	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	.00
		-	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	.00
		-	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	-	.00
		-	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	.00
		-	.00	.00	.00	.00	.00	.00	.00	.00	-	.00	-	-	-	-	.00
		-	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	-	.00
		-	-	.00	.00	.00	.00	.00	-	-	-	-	-	-	-	-	.00
		-	-	.00	.00	.00	.00	.00	.33	-	-	-	-	-	-	-	.00
		-	-	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	-	.00
		-	-	.00	.00	.00	.00	.00	-	-	-	-	-	-	-	-	.00

Table 6. Stratum by stratum arithmetic mean numbers caught per standard tow generated by STRAP (A), DAP (B), and the difference in these (C). Data is for 4X haddock from survey NO31/NO32 (summer, 1984).

A.

STRAP RESULTS
SURVEY NUMBERS AT AGE PER STANDARD TOW

STRATUM	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	TOTAL
70	.00	.00	.11	.64	2.55	2.34	3.70	1.74	.97	.52	.00	.00	.00	.00	.00	12.58
71	.00	.00	.00	.30	.03	.18	.18	.05	.02	.00	.00	.00	.00	.00	.00	.46
72	1.03	8.54	15.87	4.91	8.56	3.69	3.65	1.78	.61	.20	.00	.00	.00	.00	.00	49.33
73	.00	4.65	21.55	12.89	7.49	3.86	6.02	3.09	.86	.30	.00	.00	.00	.00	.00	60.70
74	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
75	.00	.37	7.32	19.26	121.67	63.72	30.59	9.13	2.04	.47	.00	.00	.00	.00	.00	254.43
76	.00	.02	.73	1.38	4.89	1.46	.55	.22	.00	.00	.00	.00	.00	.00	.00	8.75
77	.51	.76	13.37	21.95	84.80	22.19	4.96	1.63	.50	.13	.00	.00	.00	.00	.00	150.81
78	.00	.00	.96	2.90	9.11	2.12	.74	.32	.09	.24	.00	.00	.12	.00	.00	16.73
80	4.97	28.66	72.08	26.88	28.74	7.17	2.91	1.08	.26	.15	.00	.00	.00	.03	.00	172.05
81	.26	4.05	23.48	18.20	17.27	3.31	2.48	1.00	.26	.15	.00	.00	.00	.00	.00	70.77
82	.00	.02	1.52	2.30	3.81	3.35	5.58	2.73	.63	.74	.14	.00	.00	.00	.00	20.80
83	.00	.00	.00	.00	.14	2.56	10.66	8.34	3.83	1.60	.34	.00	.00	.00	.00	33.43
84	.00	.00	.04	.24	.12	.69	1.35	.77	.21	.24	.00	.00	.00	.00	.00	4.12
85	.00	.00	2.66	3.62	5.82	5.27	4.94	2.37	.74	.31	.05	.00	.00	.00	.00	26.44
90	.00	63.32	403.01	163.47	116.52	22.57	2.91	1.16	.17	.00	.00	.00	.00	.00	.00	773.73
91	.00	.00	2.34	3.91	13.53	5.53	1.24	1.07	1.79	.00	.34	.00	.00	.00	.00	29.36
95	.00	.00	.36	.49	1.22	.51	.00	.29	.15	.00	.00	.00	.00	.00	.00	3.09

B.

DAP RESULTS
SURVEY NUMBERS AT AGE PER STANDARD TOW

STRATUM	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	TOTAL
70	.00	.00	.11	.64	2.55	2.35	3.70	1.74	.97	.52	.00	.00	.00	.00	.00	12.58
71	.00	.00	.00	.00	.03	.18	.18	.05	.02	.00	.00	.00	.00	.00	.00	.46
72	1.03	8.54	15.87	4.91	8.56	3.69	3.65	1.78	.61	.20	.00	.00	.00	.00	.00	49.33
73	.00	4.65	21.55	12.89	7.49	3.86	6.02	3.09	.86	.30	.00	.00	.00	.00	.00	60.70
74	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
75	.00	.37	7.32	19.37	121.71	63.74	30.30	9.13	2.04	.47	.00	.00	.00	.00	.00	254.35
76	.00	.02	.73	1.38	4.89	1.46	.55	.22	.00	.00	.00	.00	.00	.00	.00	8.75
77	.51	.76	13.37	21.95	84.80	22.19	4.96	1.63	.50	.13	.00	.00	.00	.00	.00	150.81
78	.00	.00	.96	2.90	9.11	2.12	.74	.32	.09	.24	.00	.00	.12	.00	.00	16.73
80	4.97	28.66	72.08	26.88	28.74	7.17	2.91	1.08	.26	.15	.00	.00	.00	.03	.00	172.04
81	.26	4.05	23.48	18.20	17.27	3.31	2.48	1.00	.26	.15	.00	.00	.00	.00	.00	70.77
82	.00	.02	1.52	2.30	3.81	3.35	5.58	2.73	.63	.74	.14	.00	.00	.00	.00	20.99
83	.00	.00	.00	.00	.14	2.56	10.66	8.34	3.83	1.60	.34	.00	.00	.00	.00	33.43
84	.00	.00	.04	.24	.12	.69	1.35	.77	.21	.24	.00	.00	.00	.00	.00	4.12
85	.00	.00	2.66	3.62	5.82	5.27	4.94	2.37	.74	.31	.05	.00	.00	.00	.00	26.44
90	.00	63.32	403.96	163.46	116.51	22.57	2.91	1.16	.17	.00	.00	.00	.00	.00	.00	773.65
91	.00	.00	2.34	3.91	13.53	5.53	1.24	1.07	1.79	.00	.34	.00	.00	.00	.00	29.36
95	.00	.00	.36	.49	1.22	.51	.00	.29	.15	.00	.00	.00	.00	.00	.00	3.09

C.

(DAP RESULTS - STRAP RESULTS) / STRAP RESULTS

STRATUM	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	TOTAL
70	-	-	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	.00
71	-	-	-	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	.00
72	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	.00
73	-	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	.00
74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
75	-	-.03	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	.00	-	.00
76	-	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	.00
77	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	-	.00
78	-	-	.00	.00	.00	.00	.00	.00	.00	.00	-	-	.00	-	-	.00
80	.00	.00	.00	.00	.00	.00	.01	.00	.00	.00	-	-	-	-	-	.00
81	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	-	.00	-	-	.00
82	-	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	.00
83	-	-	-	-	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	.00
84	-	-	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	-	.00
85	-	-	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	.00	-	-	.00
90	-	.00	.00	.00	.00	.00	.00	.00	.00	-	.00	-	-	-	-	.00
91	-	-	.00	.00	.00	.00	.00	.00	.00	-	.00	-	-	-	-	.00
95	-	-	.00	.00	.00	.00	.00	.00	.00	-	.00	-	-	-	-	.00

Table 7. Stratum by stratum variance (numbers) generated by STRAP (A), DAP (B), and the difference in these (C). Data is for 4X haddock from survey NO31/NO32 (summer, 1984).

A.

STRAP RESULTS
SURVEY NUMBERS AT AGE PER STANDARD TOW

STRATUM	0	1	2	3	4	5	6	7	8	9	10	11	12	13	NA	TOTAL
70	.00	.00	.02	.02	1.49	.49	.00	.35	.21	.22	.00	.00	.00	.00	.00	5.38
71	.00	.00	.00	.00	.03	.07	.07	.00	.00	.00	.00	.00	.00	.00	.00	.42
72	2.12	113.18	494.65	48.13	143.70	23.54	20.38	5.45	.65	.08	.00	.00	.00	.00	.00	4361.97
73	.00	22.30	397.96	110.01	15.29	.10	4.92	1.58	.20	.03	.00	.00	.00	.00	.00	1211.21
74	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
75	.00	.22	60.65	606.98	27937.04	7732.21	1529.21	106.22	4.87	.00	.00	.00	.00	.01	.00	115292.66
76	.00	.00	.10	1.78	1.20	.95	.12	.00	.00	.00	.00	.00	.00	.00	.00	.53
77	.53	.44	5.46	421.86	8900.85	435.39	2.93	.56	.01	.01	.00	.00	.00	.00	.00	18528.13
78	.00	.00	2.76	22.04	104.79	3.64	2.28	.31	.00	.18	.00	.00	.00	.00	.00	248.18
80	17.94	672.77	2565.54	309.58	565.55	9.22	3.01	.69	.14	.03	.00	.00	.00	.00	.00	3655.48
81	.26	65.62	493.52	140.38	233.05	11.90	7.20	2.37	.58	.08	.00	.00	.00	.00	.00	2087.83
82	.00	.00	4.24	10.57	29.00	22.33	62.32	14.95	4.46	1.16	.04	.00	.00	.07	.00	873.97
83	.00	.00	.00	.00	.04	11.43	121.12	34.62	4.65	1.77	.39	.07	.02	.03	.00	579.19
84	.00	.00	.01	.18	.04	.52	2.63	.74	.07	.31	.03	.04	.00	.01	.00	28.51
85	.00	.00	17.81	19.61	14.45	6.39	9.61	2.01	.38	.92	.01	.00	.04	.01	.00	315.94
90	.00	8733.78	277673.44	41694.87	20777.42	532.28	4.52	2.74	.68	.60	.00	.00	.00	.00	.00	984017.62
91	.03	.00	.24	3.81	102.04	21.03	.90	.58	.94	.60	.35	.00	.00	.00	.00	302.88
95	.00	.00	.26	.49	2.99	.52	.01	.17	.04	.00	.00	.07	.00	.00	.00	19.07

B.

DAP RESULTS
SURVEY NUMBERS AT AGE PER STANDARD TOW

STRATUM	0	1	2	3	4	5	6	7	8	9	10	11	12	13	NA	TOTAL
70	.00	.00	.02	.02	1.49	.49	.00	.35	.21	.22	.00	.00	.00	.00	.00	5.38
71	.00	.00	.00	.00	.03	.07	.07	.00	.00	.00	.00	.00	.00	.00	.00	.42
72	2.12	113.18	494.65	48.13	143.70	23.54	20.38	5.45	.65	.08	.00	.00	.00	.00	.00	4361.97
73	.00	22.30	397.96	110.01	15.29	.10	4.92	1.58	.20	.03	.00	.00	.00	.00	.00	1211.21
74	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
75	.00	.22	60.65	606.98	27937.04	7732.21	1529.21	106.22	4.87	.00	.00	.00	.00	.01	.00	115292.66
76	.00	.00	.10	1.78	1.20	.95	.12	.00	.00	.00	.00	.00	.00	.00	.00	.53
77	.53	.44	5.46	421.86	8900.85	435.39	2.93	.56	.01	.01	.00	.00	.00	.00	.00	18528.13
78	.00	.00	2.76	22.04	104.79	3.64	2.28	.31	.00	.18	.00	.00	.00	.00	.00	248.18
80	17.94	672.77	2565.54	309.58	565.55	9.22	3.01	.69	.14	.03	.00	.00	.00	.00	.00	3655.48
81	.26	65.62	493.52	140.38	233.05	11.90	7.20	2.37	.58	.08	.00	.00	.00	.00	.00	2087.83
82	.00	.00	4.24	10.57	29.00	22.33	62.32	14.95	4.46	1.16	.04	.00	.00	.07	.00	873.97
83	.00	.00	.00	.00	.04	11.43	121.12	34.62	4.65	1.77	.39	.07	.02	.03	.00	579.19
84	.00	.00	.01	.18	.04	.52	2.63	.74	.07	.31	.03	.04	.00	.01	.00	28.51
85	.00	.00	17.81	19.61	14.45	6.39	9.61	2.01	.38	.92	.01	.00	.04	.01	.00	315.94
90	.00	8727.56	277465.89	41652.73	20781.42	531.81	4.52	2.74	.68	.60	.00	.00	.00	.00	.00	983795.06
91	.00	.00	.24	3.81	102.05	21.03	.90	.58	.94	.60	.35	.00	.00	.00	.00	302.88
95	.00	.00	.26	.49	2.99	.52	.01	.17	.04	.00	.00	.07	.00	.00	.00	19.07

C.

(DAP RESULTS - STRAP RESULTS) / STRAP RESULTS

STRATUM	0	1	2	3	4	5	6	7	8	9	10	11	12	13	NA	TOTAL
70	-	-	.00	.00	.00	.00	-	.00	.00	.00	-	-		-	-	.00
71	-	-	-	-	-	.00	.00	-	-	-	-	-		-	-	.00
72	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	-		-	-	.00
73	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	-		-	-	.00
74	-	-	-	-	-	-	-	-	-	-	-	-		-	-	.00
75	-	-.00	.00	.00	.00	.00	.00	.00	.00	-	-	-		.00	-	.00
76	-	-	.00	.00	.00	.00	.00	-	-	-	-	-		-	-	.00
77	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	.00
78	-	-	.00	.00	.00	.00	.00	.00	.00	.00	-	-		-	-	.00
80	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	-	.00	-	-	.00
81	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	-		-	-	.00
82	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	-		-	-	.00
83	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	-		-	-	.00
84	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-		.00	-	.00
85	-	-	.00	.00	.00	.00	.00	.00	.00	.00	-	.03	.00	.00	-	.00
90	-	-	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	.00	.00	-	.00
91	-	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-	.00
95	-	-	.00	.00	.00	.00	.00	.00	.00	-	.00	-		-	-	.00

Table 8. Stratum by stratum arithmetic mean numbers caught per standard tow generated by STRAP (A), DAP (B), and the difference in these (C). Data is for 4X haddock from survey N048/N049 (summer, 1985).

A.

STRAP RESULTS
SURVEY NUMBERS AT AGE PER STANDARD TOW

STRATUM	0	1	2	3	4	5	6	7	8	9	10	11	12	13	NA	TOTAL
70	.00	.00	.03	.39	.12	.33	.09	.02	.00	.00	.00	.00	.00	.00	.00	.97
71	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
72	.00	.81	7.13	33.90	19.26	10.30	1.78	.22	.00	.00	.00	.00	.00	.00	.00	73.40
73	.00	.24	3.21	31.71	70.64	49.93	11.66	1.63	.08	.00	.00	.00	.00	.00	.00	189.10
74	.00	12.01	5.95	36.71	41.59	31.53	5.38	1.07	.15	.00	.10	.00	.00	.00	.00	134.50
75	.00	14.20	9.53	30.99	23.41	19.84	3.23	.42	.03	.00	.00	.00	.00	.00	.00	100.85
76	.00	12.98	38.26	124.91	109.78	55.98	8.25	1.44	.18	.00	.10	.00	.00	.00	.00	369.87
77	.00	25.31	12.78	34.40	11.16	4.89	3.16	.41	.03	.00	.00	.00	.00	.00	.00	92.13
78	.00	.00	.15	4.83	10.75	4.48	.20	.01	.00	.00	.00	.00	.00	.00	.00	20.42
80	.00	23.32	14.67	35.55	21.52	17.31	3.15	.52	.06	.00	.05	.00	.00	.00	.00	117.45
81	.00	.93	.37	5.02	6.19	3.10	2.38	.80	.07	.00	.00	.00	.00	.00	.00	18.68
82	.00	.00	.00	.00	.00	.03	.22	.97	.03	.00	.00	.00	.16	.00	.00	1.45
83	.00	.00	.01	1.14	2.71	2.15	4.32	3.18	.52	.00	.19	.00	.16	.00	.00	14.58
84	.00	.00	.00	.02	.26	.54	.94	.74	.06	.00	.06	.00	.11	.00	.00	2.94
85	.00	.37	1.24	19.43	29.52	18.91	7.88	3.05	.35	.08	.00	.00	.00	.00	.00	80.44
90	.00	11.36	29.87	89.71	14.21	13.49	1.68	.12	.00	.00	.00	.00	.00	.00	.92	160.56
91	.00	.00	.00	1.44	1.14	7.79	4.88	.73	.37	.00	.00	.00	.00	.00	.00	16.34
95	.00	.92	.35	1.86	.35	1.23	.44	.07	.00	.00	.00	.00	.00	.00	.00	5.22

B.

DAP RESULTS
SURVEY NUMBERS AT AGE PER STANDARD TOW

STRATUM	0	1	2	3	4	5	6	7	8	9	10	11	12	13	NA	TOTAL
70	.00	.00	.03	.39	.12	.33	.09	.02	.00	.00	.00	.00	.00	.00	.00	.97
71	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
72	.00	.81	7.13	33.90	19.26	10.30	1.78	.22	.00	.00	.00	.00	.00	.00	.00	73.40
73	.00	.24	3.21	31.71	70.64	49.93	11.66	1.63	.08	.00	.00	.00	.00	.00	.00	189.10
74	.00	12.01	5.95	36.71	41.59	31.53	5.38	1.07	.15	.00	.10	.00	.00	.00	.00	134.50
75	.00	14.20	9.53	30.99	23.41	19.84	3.23	.42	.03	.00	.00	.00	.00	.00	.00	100.85
76	.00	12.98	38.26	124.91	109.78	55.98	8.25	1.44	.18	.00	.10	.00	.00	.00	.00	369.87
77	.00	25.31	12.78	34.40	11.16	4.89	3.16	.41	.03	.00	.00	.00	.00	.00	.00	92.13
78	.00	.00	.15	4.83	10.75	4.48	.20	.01	.00	.00	.00	.00	.00	.00	.00	20.42
80	.00	23.32	14.67	35.55	21.52	17.31	3.15	.52	.06	.00	.05	.00	.00	.00	.00	117.45
81	.00	.93	.37	5.02	6.19	3.10	2.38	.80	.07	.00	.00	.00	.00	.00	.00	18.68
82	.00	.00	.00	.00	.00	.03	.22	.97	.03	.00	.00	.00	.16	.00	.00	1.45
83	.00	.00	.01	1.14	2.71	2.15	4.32	3.18	.52	.00	.19	.00	.16	.00	.00	14.58
84	.00	.00	.00	.02	.26	.54	.94	.74	.06	.00	.06	.00	.11	.00	.00	2.94
85	.00	.37	1.24	19.43	29.52	18.91	7.88	3.05	.35	.08	.00	.00	.00	.00	.00	80.44
90	.00	11.36	29.87	89.71	14.21	13.49	1.68	.12	.00	.00	.00	.00	.00	.00	.92	160.56
91	.00	.00	.00	1.44	1.14	7.79	4.88	.73	.37	.00	.00	.00	.00	.00	.00	16.34
95	.00	.92	.35	1.86	.35	1.23	.44	.07	.00	.00	.00	.00	.00	.00	.00	5.22

C.

(DAP RESULTS - STRAP RESULTS) / STRAP RESULTS

STRATUM	0	1	2	3	4	5	6	7	8	9	10	11	12	13	NA	TOTAL
70	-	-	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	-	.00
71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72	-	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	-	.00
73	-	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	.00
74	-	.00	.00	.00	.00	.00	.00	.00	.00	-	.00	-	-	-	-	.00
75	-	.00	.00	.00	.00	.00	.00	.00	.00	-	.00	-	-	-	-	.00
76	-	.00	.00	.00	.00	.00	.00	.00	.00	-	.00	-	-	-	-	.00
77	-	.00	.00	.00	.00	.00	.00	.00	.00	-	.00	-	-	-	-	.00
78	-	-	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	.00
80	-	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	-	.00
81	-	.00	.00	.00	.00	.00	.00	.00	.00	-	.00	-	-	-	-	.00
82	-	-	-	-	-	.00	.00	.00	.00	-	-	-	-	-	-	.00
83	-	-	.00	.00	.00	.00	.00	.00	.00	-	.00	-	.00	-	-	.00
84	-	-	-	.00	.00	.00	.00	.00	.00	-	.00	-	.00	-	-	.00
85	-	.00	.00	.00	.00	.00	.00	.00	.00	-	.00	-	-	-	-	.00
90	-	.00	.00	.00	.00	.00	.00	.00	.00	-	.00	-	-	-	-	.00
91	-	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	.00	.00
95	-	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	.00

Table 9. Stratum by stratum variance (numbers) generated by STRAP (A), DAP (B), and the difference in these (C). Data is for 4X haddock from survey NO48/NO49 (summer, 1985).

A.

STRAP RESULTS
SURVEY NUMBERS AT AGE PER STANDARD TOW

STRATUM	0	1	2	3	4	5	6	7	8	9	10	11	12	13	NA	TOTAL
70	.00	.00	.00	.30	.03	.22	.02	.00	.00	.00	.00	.00	.00	.00	.00	1.89
71	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
72	.00	1.31	95.44	1162.09	126.82	68.41	1.54	.00	.00	.00	.00	.00	.00	.00	.01	4765.29
73	.00	.12	8.11	183.26	5567.95	6168.79	166.19	2.36	.00	.00	.00	.00	.00	.00	.03	31703.05
74	.00	288.60	24.85	54.51	1.31	3.28	.01	.00	.01	.00	.02	.00	.00	.00	.00	819.00
75	.00	26.44	61.92	399.20	1.03	17.62	3.97	.00	.00	.00	.00	.00	.00	.00	.00	306.60
76	.00	86.04	195.26	14441.96	17930.15	3391.15	.31	1.30	.05	.00	.02	.00	.00	.00	.00	59377.03
77	.00	663.43	26.49	44.00	87.20	37.62	11.53	.19	.00	.00	.00	.00	.00	.00	.00	331.15
78	.00	.00	.02	22.73	106.98	8.27	.01	.00	.00	.00	.00	.00	.00	.00	.00	312.87
80	.00	1341.54	267.47	581.10	102.53	94.43	2.70	.05	.01	.00	.01	.00	.00	.00	.00	7443.87
81	.00	3.46	.10	39.42	37.62	2.97	1.13	.39	.01	.00	.00	.00	.00	.00	.00	186.59
82	.00	.00	.00	.00	.00	.00	.15	1.89	.00	.00	.00	.00	.05	.00	.00	4.25
83	.00	.00	.00	2.59	14.73	9.21	37.37	20.25	.55	.00	.30	.00	.05	.00	.00	425.35
84	.00	.00	.00	.00	.18	.89	2.65	.07	.01	.00	.01	.00	.04	.00	.00	11.23
85	.00	.02	3.24	635.58	1295.51	317.50	50.54	5.10	.00	.00	.02	.00	.00	.00	.00	7729.99
90	.00	867.12	1330.64	5804.92	202.57	198.60	2.70	.01	.00	.00	.00	.00	.00	.00	2.55	17614.88
91	.00	.00	.00	1.77	.22	15.29	3.41	.04	.13	.00	.00	.00	.00	.00	.00	24.29
95	.00	1.70	.24	1.37	.11	1.41	.00	.01	.00	.00	.00	.00	.00	.00	.00	.75

B.

DAP RESULTS
SURVEY NUMBERS AT AGE PER STANDARD TOW

STRATUM	0	1	2	3	4	5	6	7	8	9	10	11	12	13	NA	TOTAL
70	.00	.00	.00	.30	.03	.22	.02	.00	.00	.00	.00	.00	.00	.00	.00	1.89
71	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
72	.00	1.31	85.44	1162.10	126.82	68.41	1.54	.00	.00	.00	.00	.00	.00	.00	.00	4765.28
73	.00	.12	8.12	183.25	5567.87	6168.83	168.20	2.36	.00	.00	.00	.00	.00	.00	.00	31703.13
74	.00	288.60	24.84	54.51	1.31	3.28	.01	.00	.01	.00	.02	.00	.00	.00	.00	819.99
75	.00	26.44	61.92	399.20	1.03	17.61	3.97	.00	.00	.00	.00	.00	.00	.00	.00	306.62
76	.00	86.58	193.91	14394.80	17879.97	3380.15	.29	1.30	.06	.00	.02	.00	.00	.00	.00	59219.22
77	.00	663.43	26.50	44.01	87.20	37.63	11.52	.19	.00	.00	.00	.00	.00	.00	.00	331.15
78	.00	.00	.02	22.73	106.98	8.27	.01	.00	.00	.00	.00	.00	.00	.00	.00	312.87
80	.00	1341.56	267.47	581.10	102.53	94.43	2.70	.05	.01	.00	.01	.00	.00	.00	.00	7443.77
81	.00	3.46	.10	39.42	37.62	2.97	1.13	.39	.01	.00	.00	.00	.00	.00	.00	186.59
82	.00	.00	.00	.00	.00	.00	.15	1.89	.00	.00	.00	.00	.05	.00	.00	4.25
83	.00	.00	.00	2.59	14.73	9.21	37.37	20.26	.55	.00	.30	.00	.05	.00	.00	425.36
84	.00	.00	.00	.00	.18	.89	2.65	.07	.01	.00	.01	.00	.03	.00	.00	11.24
85	.00	.02	3.23	635.57	1295.51	317.49	50.54	5.10	.00	.00	.02	.00	.00	.00	.00	7729.96
90	.00	867.13	1330.65	5802.35	202.58	198.47	2.70	.01	.00	.00	.00	.00	.00	.00	.54	19616.82
91	.00	.00	.00	1.77	.22	15.29	3.41	.04	.13	.00	.00	.00	.00	.00	.00	24.29
95	.00	1.70	.24	1.37	.11	1.41	.00	.01	.00	.00	.00	.00	.00	.00	.00	.75

C.

(DAP RESULTS - STRAP RESULTS) / STRAP RESULTS

STRATUM	0	1	2	3	4	5	6	7	8	9	10	11	12	13	NA	TOTAL
70	-	-	-	.00	.00	.00	.00	-	-	-	-	-	-	-	-	.00
71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72	-	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	-	-	.00
73	-	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	-	.00
74	-	.00	.00	.00	.00	.00	.00	-	.00	-	.00	-	-	-	-	.00
75	-	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	-	-	.00
76	-	.01	.01	.00	.00	.00	.07	.00	.00	-	.00	-	-	-	-	.00
77	-	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	-	.00
78	-	-	.00	.00	.00	.00	.00	-	-	-	-	-	-	-	-	.00
80	-	.00	.00	.00	.00	.00	.00	.00	.00	-	.00	-	-	-	-	.00
81	-	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	.00
82	-	-	-	-	-	-	.00	.00	-	-	-	-	.00	-	-	.00
83	-	-	-	.00	.00	.00	.00	.00	.00	-	.00	-	.00	-	-	.00
84	-	-	-	.00	.00	.00	.00	.00	.00	-	.00	-	.33	-	-	.00
85	-	.00	.00	.00	.00	.00	.00	.00	-	-	.00	-	-	-	-	.00
90	-	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	.00	.00
91	-	-	-	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	.00
95	-	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-	-	.00

Table 10. Stratum by stratum delta mean numbers caught per standard tow generated by Smith (A), DAP (B), and the difference in these (C). Data is for 4X haddock from survey N048/ N049 (summer, 1985).

A.

SURVEY NUMBERS AT AGE PER STANDARD TOW

STRATUM	0	1	2	3	4	5	6	7	8	9	10	11	12
70	.00	.00	.01	.39	.12	.33	.09	.02	.00	.00	.00	.00	.00
71	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
72	.00	.81	7.13	33.90	19.26	10.30	1.78	.22	.00	.00	.00	.01	.00
73	.00	.24	3.21	31.70	70.64	59.93	11.66	1.63	.08	.00	.00	.00	.00
74	.00	12.01	5.95	36.71	41.59	31.53	5.38	1.07	.15	.00	.10	.00	.00
75	.00	14.20	8.53	30.99	23.61	19.84	3.23	.42	.03	.00	.00	.00	.00
76	.00	32.98	36.26	124.90	109.78	55.98	8.25	1.14	.19	.00	.10	.00	.00
77	.00	25.31	12.78	34.39	11.16	4.88	3.15	.41	.03	.00	.00	.00	.00
78	.00	.00	.16	4.74	10.39	4.43	.20	.01	.00	.00	.00	.00	.00
80	.00	19.31	14.16	35.98	22.23	19.08	3.15	.53	.06	.00	.05	.00	.00
81	.00	.93	.37	5.06	6.13	3.22	2.38	.84	.07	.00	.00	.00	.00
82	.00	.00	.00	.00	.00	.03	.27	.97	.03	.00	.00	.00	.16
83	.00	.00	.01	1.14	2.71	2.15	4.33	3.18	.52	.00	.39	.00	.16
84	.00	.00	.00	.02	.25	.54	.94	.94	.07	.00	.04	.00	.11
85	.00	.07	1.24	19.43	29.55	18.91	11.16	3.36	.22	.00	.08	.00	.00
90	.00	11.36	29.87	147.38	20.19	16.10	1.58	.12	.00	.00	.00	.00	.00
91	.00	.00	.00	1.44	1.14	7.99	4.88	.73	.37	.00	.00	.00	.00
95	.00	.92	.35	1.86	.35	1.23	.44	.07	.00	.00	.00	.00	.00

B.

DAP RESULTS
SURVEY NUMBERS AT AGE PER STANDARD TOW

STRATUM	0	1	2	3	4	5	6	7	8	9	10	11	12
70	.00	.00	.01	.39	.12	.33	.09	.02	.00	.00	.00	.00	.00
71	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
72	.00	.81	7.13	33.89	19.26	10.30	1.78	.22	.00	.00	.00	.00	.00
73	.00	.24	3.21	31.70	70.64	59.93	11.66	1.63	.08	.00	.00	.00	.00
74	.00	12.01	5.95	36.71	41.59	31.53	5.38	1.07	.15	.00	.10	.00	.00
75	.00	14.20	8.53	30.99	23.61	19.84	3.23	.42	.03	.00	.00	.00	.00
76	.00	32.98	36.26	124.91	109.78	55.98	8.25	1.44	.19	.00	.10	.00	.00
77	.00	25.31	12.78	34.39	11.16	4.88	3.15	.41	.03	.00	.00	.00	.00
78	.00	.00	.16	4.74	10.39	4.43	.20	.01	.00	.00	.00	.00	.00
80	.00	19.31	14.16	35.98	22.23	19.08	3.15	.53	.06	.00	.05	.00	.00
81	.00	.93	.37	5.06	6.13	3.22	2.38	.84	.07	.00	.00	.00	.00
82	.00	.00	.00	.00	.00	.03	.27	.97	.03	.00	.00	.00	.16
83	.00	.00	.01	1.14	2.71	2.15	4.33	3.18	.52	.00	.39	.00	.16
84	.00	.00	.00	.02	.25	.54	.94	.94	.07	.00	.04	.00	.11
85	.00	.07	1.24	19.43	29.55	18.91	11.16	3.36	.22	.00	.08	.00	.00
90	.00	11.36	29.87	147.38	20.19	16.10	1.58	.12	.00	.00	.00	.00	.00
91	.00	.00	.00	1.44	1.14	7.99	4.88	.73	.37	.00	.00	.00	.00
95	.00	.92	.35	1.86	.35	1.23	.44	.07	.00	.00	.00	.00	.00

C.

(DAP RESULTS - SMITH RESULTS) / SMITH RESULTS

STRATUM	0	1	2	3	4	5	6	7	8	9	10	11	12
70	-	-	.00	.00	.00	.00	.00	.00	-	-	-	-	-
71	-	-	-	-	-	-	-	-	-	-	-	-	-
72	-	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-
73	-	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-
74	-	.00	.00	.00	.00	.00	.00	.00	.00	-	.00	-	-
75	-	.00	.00	.00	.00	.00	.00	.00	.00	-	.00	-	-
76	-	.00	.00	.00	.00	.00	.00	.00	.00	-	.00	-	-
77	-	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-
78	-	-	.00	.00	.00	.00	.00	.00	-	-	-	-	-
80	-	.00	.00	.00	.00	.00	.00	.00	.00	-	.00	-	-
81	-	.00	.00	.00	.00	.00	.00	.00	.00	-	-	-	-
82	-	-	-	-	-	.00	.00	.00	.00	-	-	-	.00
83	-	-	.00	.00	.00	.00	.00	.00	.00	-	.00	-	.00
84	-	-	-	.00	.00	.00	.00	.01	.17	-	.17	-	.50
85	-	.00	.00	.00	.00	.00	.00	.00	.00	-	.00	-	-
90	-	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-
91	-	-	-	.00	.00	.00	.00	.00	.00	-	-	-	-
95	-	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-

Table 11. Stratum by stratum variance in delta mean numbers caught per standard tow generated by Smith (A), DAP (B), and the difference in these (C). Data is for 4X haddock from survey N048/N049 (summer, 1985).

A.

SMITH RESULTS
SURVEY NUMBERS AT AGE PER STANDARD TOW

STRATUM	0	1	2	3	4	5	6	7	8	9	10	11	12
70	.00	.00	.00	.15	.01	.11	.01	.00	.00	.00	.00	.00	.00
71	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
72	.00	.65	42.72	581.05	63.41	34.20	.77	.00	.00	.00	.00	.00	.00
73	.00	.06	4.06	91.62	2783.93	3084.41	84.10	1.18	.00	.00	.00	.00	.00
74	.00	144.30	12.42	27.25	.66	1.64	.01	.00	.00	.00	.01	.00	.00
75	.00	13.22	30.96	199.60	.51	8.81	1.99	.00	.00	.00	.00	.00	.00
76	.00	43.29	96.95	7197.40	8939.99	1690.07	.15	.65	.03	.00	.01	.00	.00
77	.00	331.71	13.25	22.00	43.60	18.81	5.76	.09	.00	.00	.00	.00	.00
78	.00	.00	.01	6.40	22.86	2.20	.00	.00	.00	.00	.00	.00	.00
80	.00	156.96	44.44	93.94	54.09	80.78	.68	.02	.00	.00	.00	.00	.00
81	.00	.86	.33	9.99	9.42	1.42	.30	.15	.00	.00	.00	.00	.00
82	.00	.00	.00	.00	.00	.00	.07	.94	.00	.00	.00	.00	.03
83	.00	.00	.00	1.30	7.37	4.60	18.61	10.13	.27	.20	.15	.00	.03
84	.00	.00	.00	.00	.06	.30	.86	.03	.00	.00	.00	.00	.01
85	.00	.01	1.08	211.86	431.84	105.83	89.64	4.38	.00	.00	.01	.00	.00
90	.00	129.04	443.55	24062.93	304.26	153.79	.90	.00	.00	.00	.00	.00	.00
91	.00	.00	.00	.59	.08	7.91	.82	.01	.04	.00	.00	.00	.00
95	.00	.85	.12	.69	.06	.70	.00	.00	.00	.00	.00	.00	.00

B.

DAP RESULTS
SURVEY NUMBERS AT AGE PER STANDARD TOW

STRATUM	0	1	2	3	4	5	6	7	8	9	10	11	12
70	.00	.00	.00	.15	.01	.11	.01	.00	.00	.00	.00	.00	.00
71	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
72	.00	.65	42.72	581.05	63.41	34.20	.77	.00	.00	.00	.00	.00	.00
73	.00	.06	4.06	91.62	2783.93	3084.41	84.10	1.18	.00	.00	.00	.00	.00
74	.00	144.30	12.42	27.25	.66	1.64	.01	.00	.00	.00	.01	.00	.00
75	.00	13.22	30.96	199.60	.51	8.81	1.99	.00	.00	.00	.00	.00	.00
76	.00	43.29	96.95	7197.40	8939.99	1690.07	.15	.65	.03	.00	.01	.00	.00
77	.00	331.71	13.25	22.01	43.60	18.81	5.76	.09	.00	.00	.00	.00	.00
78	.00	.00	.01	6.40	22.86	2.20	.00	.00	.00	.00	.00	.00	.00
80	.00	156.96	44.44	93.94	54.09	80.78	.68	.02	.00	.00	.00	.00	.00
81	.00	.86	.33	9.99	9.42	1.42	.30	.15	.00	.00	.00	.00	.00
82	.00	.00	.00	.00	.00	.00	.07	.94	.00	.00	.00	.00	.03
83	.00	.00	.00	1.30	7.37	4.61	18.61	10.13	.27	.20	.15	.00	.03
84	.00	.00	.00	.00	.06	.30	.93	.03	.00	.00	.00	.00	.01
85	.00	.01	1.08	211.86	431.84	105.83	89.64	4.38	.00	.00	.01	.00	.00
90	.00	129.04	443.55	24062.93	304.26	153.79	.90	.00	.00	.00	.00	.00	.00
91	.00	.00	.00	.59	.08	7.91	.82	.01	.04	.00	.00	.00	.00
95	.00	.85	.12	.69	.05	.70	.00	.00	.00	.00	.00	.00	.00

C.

(DAP RESULTS - SMITH RESULTS) / SMITH RESULTS

STRATUM	0	1	2	3	4	5	6	7	8	9	10	11	12
70	-	-	-	.00	.00	.00	.00	-	-	-	-	-	-
71	-	-	-	-	-	-	-	-	-	-	-	-	-
72	-	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-
73	-	.00	.00	.00	.00	.00	.00	-	-	-	.00	-	-
74	-	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-
75	-	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-
76	-	.00	.00	.00	.00	.00	.00	.00	.00	-	.00	-	-
77	-	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-
78	-	-	.00	.00	.00	.00	-	-	-	-	-	-	-
80	-	.00	.00	.00	.00	.00	.00	.00	-	-	-	-	-
81	-	.00	.00	.00	.00	.00	.00	-.08	-	-	-	-	-
82	-	-	-	-	-	-	.00	.00	-	-	-	-	.00
83	-	-	-	.00	.00	.00	.00	.00	.00	-	.00	-	.00
84	-	-	-	-	.00	.00	.00	.00	-	-	-	-	.00
85	-	.00	.00	.00	.00	.00	.00	.00	-	-	.00	-	-
90	-	.00	.00	.00	.00	.00	.00	-	-	-	-	-	-
91	-	-	-	.00	.00	.00	.00	.00	.00	-	-	-	-
95	-	.00	.00	.00	.00	.00	-	-	-	-	-	-	-

```
      PROGRAM X(TAPE10,TAPE20)
      DIMENSION DATA(10)
      DO 5 I = 1,10
      DATA(I) = I/1000.0
5     CONTINUE
      WRITE (10,10) (DATA(I),I=1,10)
      REWIND 10
      READ(10,10) (DATA(I),I=1,10)
      WRITE(20,20) DATA
10    FORMAT (10F10.3)
20    FORMAT (10F10.2)
      STOP
      END
```

Figure 1. FORTRAN 66 source code of program to determine rounding procedures on CDC Cyber 824 and HP3000.

Appendix I A. GETDATA List Run
B. GETDATA Extract Run

A.

```
/getdata
                    MARINE FISH DIVISION DATA LIBRARY SYSTEM

  THIS SYSTEM PROVIDES THE USER WITH ACCESS TO DATA CONTAINED
  WITHIN THE MFD TAPE LIBRARY.  THIS DATA IS BROKEN DOWN, BY
  TYPE, INTO SEVERAL DIRECTORIES LOCATED IN ACCOUNT CMF0101.

  IF RUNNING ON HP 3000 THE TERMINAL MUST BE IN UPPER CASE

  THE DEFAULT VALUE FOR EACH PROMPT IS ENCLOSED IN BRACKETS
  THE USER MAY RESPOND TO ANY PROMPT WITH 'E' TO STOP

  FUNCTION (L)------------------------->? l

  DATA TYPE (INTERNAL)----------------->? &r

  SEARCH TYPE (NAME)------------------->? nas

  ENTRY NAM(S) (NO DEFAULT)------------>? n03105 n03106,n03205-n03208
* TOTAL RECORD COUNT = 19036
***** GROS113, N03105 - GROUNDFISH RESEARCH SURVEY-TYPE=RESSUM.
LABEL,GGGTAPE,VSN=MF0340.
SKIPR,GGGTAPE,0113.
COPYDR,GGGTAPE,N03105,1.
REWIND,GGGTAPE,N03105.
***** GROS114, N03106 - GROUNDFISH RESEARCH SURVEY TYPE=RESSUM.
LABEL,GGGTAPE,VSN=MF0340.
SKIPR,GGGTAPE,0113.
COPYDR,GGGTAPE,N03106,1.
REWIND,GGGTAPE,N03106.
***** GROS115, N03107 - GROUNDFISH RESEARCH SURVEY-TYPE=RESSUM.
LABEL,GGGTAPE,VSN=MF0340.
SKIPR,GGGTAPE,0114.
COPYDR,GGGTAPE,N03107,1.
REWIND,GGGTAPE,N03107.
***** GROS116, N03108 - GROUNDFISH RESEARCH SURVEY-TYPE=RESSUM.
LABEL,GGGTAPE,VSN=MF0340.
SKIPR,GGGTAPE,0115.
COPYDR,GGGTAPE,N03108,1.
REWIND,GGGTAPE,N03108.
***** GROS117, N03205 - GROUNDFISH RESEARCH SURVEY-TYPE=RESSUM.
LABEL,GGGTAPE,VSN=MF0340.
SKIPR,GGGTAPE,0116.
COPYDR,GGGTAPE,N03205,1.
REWIND,GGGTAPE,N03205.
***** GROS118, N03206 - GROUNDFISH RESEARCH SURVEY-TYPE=RESSUM.
LABEL,GGGTAPE,VSN=MF0340.
SKIPR,GGGTAPE,0117.
COPYDR,GGGTAPE,N03206,1.
REWIND,GGGTAPE,N03206.
***** GROS119, N03207 - GROUNDFISH RESEARCH SURVEY-TYPE=RESSUM.
LABEL,GGGTAPE,VSN=MF0340.
SKIPR,GGGTAPE,0118.
COPYDR,GGGTAPE,N03207,1.
REWIND,GGGTAPE,N03207.
***** GROS120, N03208 - GROUNDFISH RESEARCH SURVEY-TYPE=RESSUM.
LABEL,GGGTAPE,VSN=MF0340.
SKIPR,GGGTAPE,0119.
COPYDR,GGGTAPE,N03208,1.
REWIND,GGGTAPE,N03208.
```

B.

```
/getdata
                    MARINE FISH DIVISION DATA LIBRARY SYSTEM

  THIS SYSTEM PROVIDES THE USER WITH ACCESS TO DATA CONTAINED
  WITHIN THE MFD TAPE LIBRARY.  THIS DATA IS BROKEN DOWN, BY
  TYPE, INTO SEVERAL DIRECTORIES LOCATED IN ACCOUNT CMF0101.

  IF RUNNING ON HP 3000 THE TERMINAL MUST BE IN UPPER CASE

  THE DEFAULT VALUE FOR EACH PROMPT IS ENCLOSED IN BRACKETS
  THE USER MAY RESPOND TO ANY PROMPT WITH 'E' TO STOP

  FUNCTION (L)------------------------->? e

  DATA TYPE (INTERNAL)----------------->? &r

  SEARCH TYPE (NAME)------------------->? nas

  ENTRY NAM(S) (NO DEFAULT)------------>? n03105 n03106,n03205 n03208

  DATA FILE STORAGE MODE (A)----------->? a

  *** WARNING - DO NOT USE 'TAPE' TYPE NAME (IE TAPE1) ***

  PERMANENT FILE NAME (GDATA)---------->? data04
* TOTAL RECORD COUNT = 19036

  Batch Jobs will execute in normal
  For banktuff enter : 'RETURN,MFDU1'

  15.20.16. SUBMIT COMPLETE.  JOB IS ABZO.
/enquire.ujn

  JOB SC CG DG LID UJN      STATUS           EXECUTING MESSAGE

  ABZO.B.NI.3C.   .GETDATA  EXECUTING      ENDIF, BATCH2.
  ADUZ.T.CN.BC.   .ADMA     EXECUTING
```

Appendix II

A. FORTRAN 77 source listing of program SELECT
B. Keyfile for MFD utility CALLSMG

A.

```
      PROGRAM SELECT
      CHARACTER CARD*80
      OPEN (1, FILE = 'TAPE1')
      OPEN (2, FILE = 'TAPE2')
10    READ (1,'(A,T7,I2)',END=999) CARD, ISTRAT
      IF (ISTRAT .GE. 70 .AND. ISTRAT .LE. 95) THEN
            IF (CARD(1:1) .EQ. '5') GO TO 20
            IF (CARD(1:1) .EQ. '6' .AND. CARD(39:42) .EQ.
     *           '0011') GO TO 20
            IF (CARD(1:1) .EQ. '7' .AND. CARD(21:24) .EQ.
     *           '0011') GO TO 20
            IF (CARD(1:1) .EQ. '8' .AND. CARD(31:34) .EQ.
     *           '0011') GO TO 20
      ENDIF
      GO TO 10
20    WRITE (2,'(A)') CARD
      GO TO 10
999   STOP
      END
```

B.

```
FIELD,KEY1(1,1,DISPLAY)
KEY,KEY1(A,ASCII6)
FIELD,KEY2(2,4,DISPLAY)
KEY,KEY2(A,ASCII6)
FIELD,KEY3(9,2,DISPLAY)
KEY,KEY3(A,ASCII6)
```

Appendix III FORTRAN 77 source listing of Program SRPREP.

```
      PROGRAM SRPREP
      CHARACTER CARD*80,CDOUT*4000
      OPEN (1, FILE = 'TAPE1',RECL=80)
      OPEN (2, FILE = 'TAPE2',RECL=4000)
      CDOUT = ' '
      ICNT8 = 229
        ISTART = 0
10    READ (1, '(A)', END = 999) CARD
      IF (CARD(1:1) .EQ. '5') THEN
            IF (ISTART .EQ. 0) THEN
            WRITE (CDOUT(1:47),'(A4,A21,A3,A11,A2,A6)')
     *            CARD(2:5),CARD(7:27),CARD(29:31),
     *            CARD(33:43),CARD(46:47),CARD(52:57)
            ISTART = 1
         ELSE
             WRITE (2,'(A)') CDOUT
            CDOUT = ' '
        ICNT8 = 229
            WRITE (CDOUT(1:47),'(A4,A21,A3,A11,A2,A6)')
     *            CARD(2:5),CARD(7:27),CARD(29:31),
     *            CARD(33:43),CARD(46:47),CARD(52:57)
       ENDIF
      ENDIF
      IF (CARD(1:1) .EQ. '6') THEN
            WRITE (CDOUT(48:60),'(A13)') CARD(39:51)
      ENDIF
      IF (CARD(1:1) .EQ. '7') THEN
            IF (CARD(36:38) .EQ. '005') THEN
                WRITE (CDOUT(61:102),'(A42)') CARD(39:80)
            ELSEIF (CARD(36:38) .EQ. '285') THEN
                WRITE (CDOUT(103:144),'(A42)') CARD(39:80)
            ELSEIF (CARD(36:38) .EQ. '565') THEN
                WRITE (CDOUT(145:186),'(A42)') CARD(39:80)
            ELSEIF (CARD(36:38) .EQ. '845') THEN
                WRITE (CDOUT(187:228),'(A42)') CARD(39:80)
            ENDIF
      ENDIF
      IF (CARD(1:1) .EQ. '8') THEN
           IF (CARD(64:64) .EQ. '9') CARD(71:72) = '99'
           IF (CARD(67:67) .EQ. '5') CARD(71:72) = '99'
           IF (CARD(71:72) .EQ. '  ') CARD(71:72) = '99'
           WRITE (CDOUT(ICNT8:ICNT8+11),'(A10,A2)')
     *            CARD(40:49),CARD(71:72)
           ICNT8 = ICNT8+12
      ENDIF
      GO TO 10
999         WRITE (2,'(A)')CDOUT
      STOP
      END
```

Appendix IV FORTRAN 77 source listing of program SRSET of the SMS.

```
      PROGRAM SRSET
      CHARACTER CARD *4000, CRUID*4, CRUISE(29)*12
      COMMON ISTRAT,FISH,KEY70,KEY90
      REAL NOC,WOC,LENFQ(56),NAT(21),FISH(5,300),LFTOT
      REAL LTH(56), WT70(56), WT90(56), WAT(21), FACTOR
      INTEGER KEY70(56,21),KEY90(56,21),LTOT70(56),LTOT90(56)
      OPEN (2,FILE = 'TAPE2',RECL=4000)
      OPEN (4,FILE = 'TAPE4',RECL=1100)
      DATA CRUISE / 'A175A178', 'A188A189',
     *              'A200A201', 'A212A213',
     *              'A225A226', 'A236A237',
     *              'A250A251', 'A265A266',
     *              'A279A280', 'H009H010',
     *              'H013H014', 'A292A293',
     *              'H025H027', 'H033H034',
     *              'A306A307', 'H042H043',
     *              'H048H049', 'A321A322',
     *              'H064H065', 'H071H072',
     *              'H080H081', 'H084H085',
     *              'H094H095', 'N012N013N014',
     *              'N017N018', 'N024N025',
     *              'N031N032', 'N036N037',
     *              'N048N049'/
      ICNT = 1
      LTH(1) = 0.5
      DO 1 I = 2, 56
      LTH(I) = LTH(I-1) + 2.0
1     CONTINUE
      DO 2 I = 1,56
      WT70(I) = ( 0.0077585 * LTH(I) ** 3.07669)/1000.0
      WT90(I) = ( 0.0096541 * LTH(I) ** 3.03027)/1000.0
2     CONTINUE
3     REWIND 3
      IF (ICNT .GT. 1) CLOSE (3 )
      OPEN (3, STATUS = 'SCRATCH', RECL = 4000)
4     READ (2,'(A,T1,A4)',END=5) CARD,CRUID
      IF (INDEX(CRUISE(ICNT),CRUID) .GT. 0) THEN
        WRITE (3,'(A)') CARD
        GO TO 4
      ELSE
        GO TO 4
      ENDIF
5     REWIND 3
      DO 10 I = 1,56
      DO 10 J = 1,21
      KEY70(I,J) = 0
      KEY90(I,J) = 0
10    CONTINUE
40    READ (3,20,END = 30) ISTRAT,IEXPT,((FISH(I,J),I=1,5),J=1,300)
20    FORMAT (T5,I2,T18,I1,T229,300(F3.0,F1.0,F1.0,F5.3,F2.0))
      IF (IEXPT .NE. 1 ) GO TO 40
      CALL KEY
      GO TO 40
30    REWIND 3
      WRITE (5,31)  ICNT
31    FORMAT (T2,' NEW CRUISE : ICNT = ',I3)
      WRITE (5,'(21I6)') ((KEY70(I,J),J=1,21),I=1,56)
      WRITE (5,32)
32    FORMAT (' ')
      WRITE (5,'(21I6)') ((KEY90(I,J),J=1,21),I=1,56)
      DO 45 I = 1,56
      LTOT70(I) =  0
      LTOT90(I) = 0
45    CONTINUE
      DO 70 I = 1,56
      DO 70 J = 1,21
      LTOT70(I) = LTOT70(I) + KEY70(I,J)
      LTOT90(I) = LTOT90(I) + KEY90(I,J)
70    CONTINUE
110   DO 46 I = 1,21
      NAT(I) = 0.0
      WAT(I) = 0.0
46    CONTINUE
      LFTOT = 0.0
```

Appendix IV (Continued)

```
47    READ (3,50,END = 999) CARD,ISTRAT,DIST,WOC,WOC,LENFQ
50    FORMAT (A,T5,I2,T40,F2.1,T52,F5.0,F4.0,56F3.0)
      IF (CARD(18:18) .NE. '1') GO TO 47
      IF (WOC .EQ. 0.0) GO TO 95
      DO 55 I = 1, 56
      LFTOT = LFTOT + LENFQ(I)
55    CONTINUE
      DO 60 I = 1,56
      LENFQ(I) = LENFQ(I) * (1.75/DIST) * (WOC/LFTOT)
60    CONTINUE
      WOC = WOC*(1.75/DIST)
      WOC = WOC*(1.75/DIST)
      IF (ISTRAT .GE. 70 .AND. ISTRAT .LE. 85) THEN
         DO 81 I = 1,56
         IF (LTOT70(I) .EQ. 0) THEN
           IF (I .LE. 6) THEN
              NAT(1) = LENFQ(I) + NAT(1)
              WAT(1) = WT70(I) * LENFQ(I) + WAT(1)
              GO TO 81
           ELSE
              NAT(21) = LENFQ(I) + NAT(21)
              WAT(21) = WT70(I) * LENFQ(I) + WAT(21)
              GO TO 81
           ENDIF
      ENDIF
         DO 90 J = 1,21
         FACTOR=FLOAT(KEY70(I,J))/FLOAT(LTOT70(I))
         NAT(J) = (LENFQ(I)*FACTOR) + NAT(J)
         WAT(J) = (WT70(I)*LENFQ(I)*FACTOR) + WAT(J)
90       CONTINUE
81       CONTINUE
      ELSE
         DO 91 I = 1,56
         IF (LTOT90(I) .EQ. 0) THEN
           IF (I .LE. 6) THEN
              NAT(1) = LENFQ(I) + NAT(1)
              WAT(1) = WT90(I) * LENFQ(I) + WAT(1)
              GO TO 91
           ELSE
              NAT(21) = LENFQ(I) + NAT(21)
              WAT(21) = WT90(I) * LENFQ(I) + WAT(21)
              GO TO 91
           ENDIF
      ENDIF
         DO 90 J = 1,21
         FACTOR=FLOAT(KEY90(I,J))/FLOAT(LTOT90(I))
         NAT(J) = (LENFQ(I)*FACTOR)+NAT(J)
         WAT(J) = (WT90(I)*LENFQ(I)*FACTOR) + WAT(J)
90       CONTINUE
91       CONTINUE
      ENDIF
95    WRITE (4,100) CARD(1:51),WOC,WOC,LENFQ,NAT,WAT
100   FORMAT (A51,100F10.3)
      GO TO 110
999   ICNT = ICNT + 1
      IF (ICNT .GT. 29) THEN
         STOP
      ELSE
         GO TO 3
      ENDIF
      END
      SUBROUTINE KEY
      COMMON ISTRAT,FISH,KEY70,KEY90
      REAL FISH(5,300)
      INTEGER KEY70(56,21),KEY90(56,21)
      DO 10 I = 1,300
      IF (FISH(1,I) .EQ. 0.0 .OR. FISH(5,I) .EQ. 99.0) THEN
         GO TO 10
      ENDIF
      IF (FISH(1,I) .EQ. 1) K = 1
      IF (MOD(FISH(1,I),2.0) .GT. 0.0) THEN
         K = (IFIX(((FISH(1,I)-1)/2))) +1
      ELSE
         K = (IFIX(FISH(1,I)/2)) + 1
      ENDIF
      L = IFIX(FISH(5,I)+1.0)
      IF (ISTRAT .GE. 70 .AND. ISTRAT .LE. 85) THEN
         KEY70(K,L) = KEY70(K,L) + 1
      ELSE
        KEY90(K,L) = KEY90(K,L) + 1
      ENDIF
10    CONTINUE
      RETURN
      END
```

Appendix V Directives file for creation of SPSS system file.

```
                                                
```

Appendix V. (Continued)

```
IF              (MONTH LE 4) SEASON = 1
IF              (MONTH GE 5 AND MONTH LE 8) SEASON = 2
IF              (MONTH GE 9) SEASON = 3
IF              (CRUISEID EQ 'A175') VESSEL = 1
IF              (CRUISEID EQ 'A189') VESSEL = 1
IF              (CRUISEID EQ 'A200') VESSEL = 1
IF              (CRUISEID EQ 'A212') VESSEL = 1
IF              (CRUISEID EQ 'A225') VESSEL = 1
IF              (CRUISEID EQ 'A234') VESSEL = 1
IF              (CRUISEID EQ 'A250') VESSEL = 1
IF              (CRUISEID EQ 'A265') VESSEL = 1
IF              (CRUISEID EQ 'A279') VESSEL = 1
IF              (CRUISEID EQ 'A306') VESSEL = 1
IF              (CRUISEID EQ 'A321') VESSEL = 1
IF              (CRUISEID EQ 'A292') VESSEL = 1
IF              (CRUISEID EQ 'H009') VESSEL = 2
IF              (CRUISEID EQ 'H013') VESSEL = 2
IF              (CRUISEID EQ 'H028') VESSEL = 2
IF              (CRUISEID EQ 'H033') VESSEL = 2
IF              (CRUISEID EQ 'H042') VESSEL = 2
IF              (CRUISEID EQ 'H048') VESSEL = 2
IF              (CRUISEID EQ 'H064') VESSEL = 2
IF              (CRUISEID EQ 'H071') VESSEL = 2
IF              (CRUISEID EQ 'H080') VESSEL = 2
IF              (CRUISEID EQ 'H084') VESSEL = 2
IF              (CRUISEID EQ 'H094') VESSEL = 2
IF              (CRUISEID EQ 'N012') VESSEL = 3
IF              (CRUISEID EQ 'N017') VESSEL = 3
IF              (CRUISEID EQ 'N024') VESSEL = 3
IF              (CRUISEID EQ 'N031') VESSEL = 3
IF              (CRUISEID EQ 'N038') VESSEL = 3
IF              (CRUISEID EQ 'N048') VESSEL = 3
COMPUTE         NAGE = NAA000+NAA001+NAA002+NAA003+NAA004+NAA005+
                       NAA006+NAA007+NAA008+NAA009+NAA010+
                       NAA011+NAA012+NAA013+NAA014+NAA015+
                       NAA016+NAA017+NAA018 NAA019 NAA020
IF              (NOC GT 0 AND NAGE EQ 0) NAGE = 999
RECODE          STRATUM (95 = 69)
RECODE          SETDUR (20 THRU 40 = 999)
RECODE          SPEED (2 THRU 5 = 999)
SELECT IF       (STRATUM GE 69 AND STRATUM LE 91
                AND SEASON EQ 2 AND SETDUR EQ 999
                AND SPEED EQ 999 AND DIST GE 1 AND NAGE NE 999)
DO REPEAT       NAAX = NAA000 TO NAA020,NOC/
IF              ( VESSEL EQ 1 ) NAAX = NAAX*1.2
END REPEAT
DO REPEAT       WAAX = WAA000 TO WAA020,WOC/
IF              ( VESSEL EQ 1 ) WAAX = WAAX*1.2
END REPEAT
DO REPEAT
                LTHX = LTH001 TO LTH056/
IF              ( VESSEL EQ 1 ) LTHX = LTHX*1.2
END REPEAT
SAVE FILE
```

```
      PROGRAM DELTA
      CHARACTER CHAR*2,A4, CRUISE*8,CRUISE ID*12
      REAL SET(16,16),SAMP(16,16,16),CATCH(16),FACTOR(16,16),
      REAL VEC(16,16,8),MEAN(16),VAR(16),DIFF(16,16),
      REAL WEIGHT(25),WGHT(25),APEN(16),AVAR(16),ARITH,VECH
      REAL DATUM
      INTEGER I,J,K,L,M,N,I5,I8,I4,IEN,M(16)

        PROGRAM WRITTEN BY JEREN WALLACE  M.F.D

        THIS PROGRAM TAKES INPUT FILE (INDATA) AND CALCULATES
        THE FOLLOWING STATISTICS ON A STRATUM BY STRATUM AND
        CRUISE BY CRUISE BASIS:

              1) DELTA MEANS
              2) VARIANCE ABOUT THE DELTA MEAN
              3) VARIANCE IN THE DELTA MEAN
              4) ARITHMETIC MEAN
              5) VARIANCE IN ARITHMETIC MEAN

      xxxxxx NOTE THAT THERE IS A POSSIBILITY OF ERRORS IN THE xxxxx
      xxxxxx DELTA MEANS IN CASES WHERE THE DATA HAS A WIDE   xxxxx
      xxxxxx RANGE. (IE. 0.26, 900.0, 1200.)                  xxxxx


      OPEN (4,FILE = 'INDATA',RECL=200)
      OPEN (5,FILE = 'DELTMEN',RECL=200)
      OPEN (6,FILE = 'DELTVAR',RECL = 200)
      OPEN (7,FILE = 'TABLES',RECL = 200)
      OPEN (8,FILE = 'ARMEAN',RECL = 200)
      OPEN (9,FILE = 'ARVAR',RECL = 200)
      DATA CHAR/'  '/

        THE FOLLOWING DATA LIST CONTAINS THE RESEARCH VESSEL
        CRUISE NUMBERS FOR THE LADY HAMMOND, ALFRED NEEDLER AND
        THE CAMERON.

      DATA CRUISE / 'A175A176', 'A188A189',
     &              'A200A201', 'A212A213',
     &              'A225A226', 'A236A237',
     &              'A250A251', 'A265A266',
     &              'A279A280', 'H009H010',
     &              'H013H014', 'H023H023',
     &              'H026H027', 'H033H034',
     &              '4306A307', 'H042H043',
     &              'H048H049', 'A301A322',
     &              'H064H065', 'H071H072',
     &              'H080H081', 'H084H085',
     &              'H094H095', 'H012N013N014',
     &              'N017N018', 'N024N025',
     &              'N031N032', 'N036N037',
     &              'N048N049'/

        THIS DATA LIST ASSIGNS WEIGHTS TO THE STRATA FROM
        70 TO 95. IN THIS CASE STRATA 72 TO 74 ARE NULLED AND
        STRATA 95 IS INPUT AS STRATA 69 (IE FIRST WEIGHT)

      DATA WGHT/534.,920.,1004.,1249.,265.,161.,156.,1478.,1222.,233.,
     &  0.,655.,1875.,1042.,532.,2264.,1282.,0.,0.,0.,0.,0.,
     &  901.,687.,0.,0.,0./
      ICNT = 1
    4   DO 2 L=1,25
          DO 3 I=1,16
          DO 1 N=1,25
           VI(N)=0.0
    1       SAMP(L,I,N)=0.0
          DO 9 J=1,8
    9      VEC(L,I,J)=0.0
          SETN(L,I)=0.0
    2   CONTINUE
      IF (ICNT .GT. 1) REWIND  4

        READ INPUT FILE AND CHECK AGAINST CRUISE LIST
        THE STRATA ARE TRANSFORMED BY SUBTRACTING 68
        THIS MAKES STRATA 69=1 AND STRATA 94=25,ETC.

        SETN IS A COUNT OF THE NUMBER OF SETS PER STRATA
        SAMPL IS THE ARRAY CONTAINING THE CATCH DATA
        CHAR IS THE CRUISE ID READ OFF TAPE4(INDATA)

      READ (4,100,END=20) CRUID,ISTRAT,SET,(CATCH(I),I=1,16)
  100   FORMAT(A4,2I2,16(F3.3))
      IF (INDEX(CRUISE(ICNT),CRUID) .GT. 0) THEN
        ISTRAT=ISTRAT-68
        CHAR(ICNT)=CRUID
      DO 10 K=1,16
        SETN(ISTRAT,K)=SETN(ISTRAT,K)+1
        IND=IFIX(SETN(ISTRAT,K))
        SAMP(ISTRAT,K,IND)=CATCH(K)
   10 CONTINUE
        ELSE
      GOTO 5
      ENDIF
      GOTO 5
   20   IF (CHAR(ICNT).EQ.'  ') GOTO 107
        DO 21 L=1,25
          DO 22 M=1,16
            MEAN(L,M)=0.0
            VAR(L,M)=0.0
   22     CONTINUE
```

Appendix VI (Continued)

```
C
C     THIS SECTION CALLS THE SUBROUTINE FOR THE DELTA MEAN
C     CALCULATIONS AND STORES THE RESULTS IN ARRAY RES
C
C     VI CONTAINS THE ARRAY OF CATCH AT AGE PER STRATA
C     C IS THE DELTA MEAN FROM DELEMA
C     D IS THE DELTA VARIANCE IN THE DATA
C     VC IS THE VARIANCE IN THE DELTA MEAN
C     XBAR IS THE ARITHMETIC MEAN
C     XVAR IS THE VARIANCE
C
C     ITOT IS THE SUMMATION OF ALL SETS
C     IZER IS THE SUMMATION OF NON-ZERO SETS
C
C     RATIO HOLDS THE FRACTION OF NON-ZERO TO ZERO SETS
C
      DO 28 IS=1,26
       ISNUM(IS)=IS
        DO 26 IA=1,16
        M=IFIX(SETN(IS,IA))
        IF(M.LT.1) GOTO 26
          DO 24 IN=1,M
   24      VI(IN)=SAMP(IS,IA,IN)
           CALL DELEMA(VI,M,C,D,VC,XBAR,XVAR,NZERO)
           RES(IS,IA,1)=C
           RES(IS,IA,2)=D
           RES(IS,IA,3)=VC
           RES(IS,IA,4)=XBAR
           RES(IS,IA,5)=XVAR
           RES(IS,IA,6)=FLOAT(M)
           RES(IS,IA,7)=FLOAT(NZERO)
            IZER(IS,IA)=RES(IS,IA,7)
            ITOT(IS,IA)=RES(IS,IA,6)
   26    CONTINUE
   28  CONTINUE
        DO 190 J=1,16
          DO 190 K=1,26
  191     RATIO(K,J)=IZER(K,J)/ITOT(K,J)
  190   CONTINUE
C
C
C     THIS SECTION WRITES THE TABLES TO FILE 7 ('TABLES')
C
      IF(CHAR(ICNT).EQ.'    ') GOTO 127
      WRITE(7,51) CHAR(ICNT)
      WRITE(7,50)
      WRITE(7,60)
      WRITE(7,52) ((N-1),N=1,14)
      DO 200 I=1,26
  200 WRITE(7,53) (ISNUM(I)+68),(RES(I,J,1),J=1,16)
      WRITE(7,54)
      WRITE(7,60)
      WRITE(7,52) ((N-1),N=1,14)
       DO 202 I=1,26
  202 WRITE(7,53) (ISNUM(I)+68),(RES(I,J,2),J=1,16)
      WRITE(7,55)
      WRITE(7,60)
      WRITE(7,52) ((N-1),N=1,14)
       DO 204 I=1,26
  204 WRITE(7,53) (ISNUM(I)+68),(RES(I,J,3),J=1,16)
      WRITE(7,56)
      WRITE(7,60)
      WRITE(7,52) ((N-1),N=1,14)
      DO 206 I=1,26
  206 WRITE(7,53) (ISNUM(I)+68),(RES(I,J,4),J=1,16)
      WRITE(7,57)
      WRITE(7,60)
      WRITE(7,52) ((N-1),N=1,14)
      DO 208 I=1,26
  208 WRITE(7,53) (ISNUM(I)+68),(RES(I,J,5),J=1,16)
   56 FORMAT(//,76X,'TABLE OF ARITHMETIC MEANS BY STRATA')
   57 FORMAT(//,76X,'TABLE OF VARIANCE                  ')
      WRITE(7,58)
      WRITE(7,60)
      WRITE(7,52) ((N-1),N=1,14)
      DO 210 I=1,26
  210 WRITE(7,53) (ISNUM(I)+68),(ITOT(I,J),J=1,16)
      WRITE(7,59)
      WRITE(7,60)
      WRITE(7,52) ((N-1),N=1,14)
      DO 212 I=1,26
  212 WRITE(7,53) (ISNUM(I)+68),(RATIO(I,J),J=1,16)
   50  FORMAT(76X,' TABLE OF DELTA MEANS BY STRATA ')
   51  FORMAT('1',//,85X,' CRUISE NUMBER  ',A4)
   52  FORMAT(6X,14(9X,I2),9X,'NK',7X,'TOTAL',/,185('-'),/)
   53  FORMAT(3X,I2,1X,16(F11.2))
   54  FORMAT(76X,' TABLE OF DELTA VARIANCE IN DATA BY AGE/STRATA')
   55  FORMAT('1',//,75X,'TABLE OF VARIANCE IN DELTA MEAN AGE/STRATA')
   58  FORMAT('1',//,76X,'TABLE OF TOTAL NUMBER OF SETS/AGE/STRATA')
   59  FORMAT(//,76X,'TABLE OF FRACTIONS FOR NON-ZERO SETS')
   60  FORMAT(T2,'STRATUM',T90,'AGE')
```

Appendix VI (Continued)

```
C
C       THIS SECTION CALCULATES THE WEIGHTED MEANS FOR THE
C       STRATA OVER THE YEAR
C
C       THE WEIGHTING METHOD ARE FROM COCHRAN,1977 (THEOREM 5.3)
C
C       NOTE THAT BOTH DELTA MEANS AND ARITHMETIC MEANS ARE
C       WEIGHTED, AND THAT THE ZERO SETS ARE NOT INCLUDED IN THE
C       ESTIMATE OF VARIANCE BUT ARE ADDED INTO THE MEAN.
C
        DO 35 L=1,16
          ASUM=0.0
          ANS=0.0
          WSUM=0.0
          ARTH=0.0
          ASUM=0.0
         DO 34 N=1,26
          IF(SETN(N,L).EQ.0) GOTO 34
           ANS=RES(N,L,1)*WGHT(N)+ANS
           WSUM=WGHT(N)+WSUM
           NSUM=WGHT(N)*(WGHT(N)-SETN(N,L))*RES(N,L,3)+NSUM
          IF(RES(N,L,5).NE.-999.) THEN
            ASUM=WGHT(N)*(WGHT(N)-SETN(N,L))*(RES(N,L,5)/SETN(N,L))+ASUM
          ELSE
          ENDIF
            ARTH=RES(N,L,4)*WGHT(N)+ARTH
 34       CONTINUE
         MEAN(L)=ANS/WSUM
         VMEAN(L)=(1.0/(WSUM)**2)*NSUM
       AMEN(L)=ARTH/WSUM
       AVAR(L)=(1.0/WSUM**2)*ASUM
 35      CONTINUE
       IF(ICNT.EQ.1) THEN
        WRITE(5,110)
        WRITE(6,115)
        WRITE(8,130)
        WRITE(9,135)
 110    FORMAT(76X,'DELTA MEANS')
 115    FORMAT(76X,'VARIANCE IN THE DELTA MEANS')
 130    FORMAT(76X,'ARITHMETIC MEANS')
 135    FORMAT(76X,'VARIANCE IN THE ARITHMETIC MEANS')
        WRITE(5,52)  ((N-1),N=1,14)
        WRITE(6,52) ((N-1),N=1,14)
         WRITE(8,52) ((N-1),N=1,14)
         WRITE(9,52) ((N-1),N=1,14)
        GOTO 116
        ELSE
        ENDIF
 116      WRITE(5,120) CHAR(ICNT),(MEAN(N),N=1,16)
          WRITE(6,120) CHAR(ICNT),(VMEAN(N),N=1,16)
          WRITE(8,120) CHAR(ICNT),(AMEN(N),N=1,16)
          WRITE(9,120) CHAR(ICNT),(AVAR(N),N=1,16)
 120    FORMAT(3X,A4,1X,16(1X,F8.2))
 127    ICNT=ICNT+1
        IF(ICNT.LE.29) GOTO 4
        END
```

```
      SUBROUTINE DELMEA(X,NN,C,D,VC,XBAR,SGN,NNZ)
C
C     THIS SUBROUTINE WILL CALCULATE DELTA MEANS OF THE
C     LOGNORMAL TRANSFORMED CATCH DATA AS WELL AS PROVIDE
C     THE VARIANCE IN THE DATA AND THE VARIANCE IN THE MEAN.
C
C
C     THE METHODS USED IN THIS SUBROUTINE WERE EXTRACTED
C     FROM PENNINGTON (1983)
C
      REAL SX,SLX,SSLX,SS,TNUM,C,D,VC,ANS,T1,T2,T3,T4,T5,S2
      REAL LMEAN,XBAR,X(100),YL(100),SUML,SUM
      INTEGER NNZ,IT,I,J,L,NN
      SUML=0.0
      SUM=0.0
      NNZ=0
      SS=0.0
      SX=0.0
      SSLX=0.0
      SLX=0.0
      VC=0.0
      C=0.0
      D=0.0
      XBAR=0.0
      SGN=0.0
      DO 20 IT=1,NN
      IF(X(IT).NE.0.0) NNZ=NNZ+1
      IF(X(IT).EQ.0.0) GOTO 20
      YL(NNZ)=ALOG(X(IT))
      SX=SX+X(IT)
      SLX=SLX+ALOG(X(IT))
      SS=SS+X(IT)**X(IT)
      SSLX=SSLX+2.*ALOG(X(IT))
   20 CONTINUE
      IF(NNZ.EQ.0) GOTO 27
      IT=IT-1
      TNUM=FLOAT(NNZ)/FLOAT(NN)
      XBAR=SX/FLOAT(NN)
      LMEAN=SLX/FLOAT(NNZ)
      DO 25 J=1,NNZ
   25 SUML=SUML+(YL(J)-LMEAN)**2
      DO 26 L=1,NN
   26 SUM=SUM+(X(L)-XBAR)**2
      S2=SUML/(FLOAT(NNZ-1))
      IF(NN.EQ.1) THEN
        SGN=-999.
      ELSE
        SGN=SUM/FLOAT(NN-1)
      ENDIF
C
C     CALCULATE THE STATISTICS FOR NO NON-ZERO VALUES
C
   27 IF(NNZ.EQ.0) THEN
        C=0.0
        D=0.0
        XBAR=0.0
        SGN=0.0
        VC=0.0
        GOTO 100
C
C     CALCULATE STATS FOR ONE NON-ZERO VALUE
C
      ELSE IF (NNZ.EQ.1) THEN
        C=SX/NN
        D=(SX**2)/NN
        VC=C*C
        XBAR=XBAR
        SGN=SGN
        GOTO 100
C
C     CALCULATE STATS FOR MORE THAN 1 NON-ZERO VALUE
C
      ELSE IF (NNZ.GT.1) THEN
       T1=TNUM*EXP(LMEAN)
       T2=(S2/2.0)
        CALL BES(T2,NNZ,ANS)
        C=T1*ANS
C
C     CALCULATE THE VARIANCE IN THE DELTA MEAN
C
        T1=TNUM*EXP(2.0*LMEAN)
        T2=(2.0*S2)
        CALL BES(T2,NNZ,T3)
        T4=FLOAT(NNZ-2)/FLOAT(NNZ-1)
        CALL BES((T4*S2),NNZ,T5)
        D=T1*(T3-(T5*(FLOAT(NNZ-1)/FLOAT(NN-1))))
C
C     CALCULATE VARIANCE IN MEAN
C
        T2=TNUM**(ANS**ANS)-(T5*(FLOAT(NNZ-1)/FLOAT(NN-1)))
        VC=T1*T2
      ENDIF
  100 CONTINUE
      RETURN
      END
```

Appendix VI (Continued)

```
      SUBROUTINE BES(M,T,RES)
      REAL RES,X1,X2,M,TOT,ADD,F
      INTEGER T,I,J,K
C
C     THIS IS A BESSEL SUBROUTINE EXTRACTED FROM
C     THE METHODS OF PENNINGTON (1983) AND MODIFIED FROM
C     SOME M.F.D. SOFTWARE.
C
       TOT=0.0
        IF(M.EQ.0.0) THEN
           RES=1.0
          RETURN
        ELSE
        END IF
       DO 40 I=2,25
        X1=(FLOAT(T-1))**(2*I-1)
        X2=1.0
         DO 10 K=1,2*I-3,2
           X2=X2*(FLOAT(T+K))
10        CONTINUE
        F=1.0
        DO 20 J=1,I
          F=F*FLOAT(J)
20      CONTINUE
        ADD=(X1/(X2*FLOAT(T)**I))*((M**I)/F)
        TOT=TOT+ADD
        IF(ADD.LT.0.00001) GOTO 50
40      CONTINUE
        WRITE(*,*) ('CONVERGENCE PROBLEM IN SUBROUTINE BES ')
50      CONTINUE
        RES=1.0+M*(FLOAT(T-1))/(FLOAT(T))+TOT
        RETURN
        END
```

(1)
$$c = \begin{cases} \dfrac{m}{n}\exp(\bar{y})G_m(\tfrac{1}{2}s^2), & m > 1, \\ \dfrac{x_1}{n}, & m = 1, \\ 0, & m = 0. \end{cases}$$

(2)
$$d = \begin{cases} \dfrac{m}{n}\exp(2\bar{y})\left\{G_m(2s^2) - \left(\dfrac{m-1}{n-1}\right)G_m\left(\dfrac{m-2}{m-1}s^2\right)\right\}, & m > 1, \\ \dfrac{x_1^2}{n}, & m = 1, \\ 0, & m = 0. \end{cases}$$

where $\bar{y}$ and s^2 are the sample mean and sample variance, respectively, of the log of the nonzero values and

(3)
$$G_n(t) = 1 + \frac{n-1}{n}t + \underbrace{\sum_{j=2}^{\infty} \frac{(n-1)^{2j-1}}{n^j(n+1)(n+3)\cdots(n+2j-3)} \times \frac{t^j}{j!}}_{\text{ADD}}.$$

(4)
$$\operatorname{var}_{\text{est}}(c) = \begin{cases} \dfrac{m}{n}\exp(2\bar{y})\left\{\dfrac{m}{n}G_m^2(\tfrac{1}{2}s^2) - \left(\dfrac{m-1}{n-1}\right)G_m\left(\dfrac{m-2}{m-1}s^2\right)\right\}, & m > 1, \\ \left(\dfrac{x_1}{n}\right)^2, & m = 1, \\ 0, & m = 0. \end{cases}$$

Appendix VII Equations used in calculation of stratum by stratum mean and variances assuming Delta distribution.

(1) Mean
(2) Variance of Sample
(3) Bessel function used in (2)
(4) Variance of Mean

Note: See Pennington (1983) for details.